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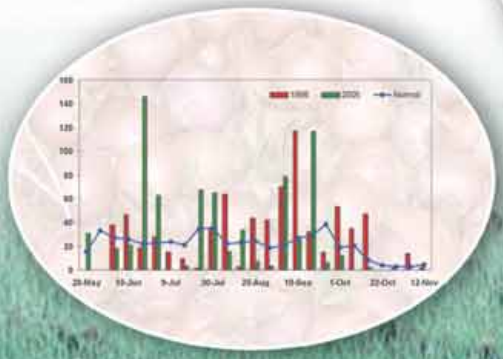
Impact of excess rains on yield, market availability and prices of onion



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Foreword

Weather plays a predominant role in crop growth and productivity. Aberrant weather conditions have always been unpredictable and often impairing realizable crop yields. Sporadic heat- or cold-wave conditions and the extensive variability in quantity and distribution of the rainfall leading to continuous wet spells have been causing severe crop damages and extensive economic losses to the farmers.

Onion is one of the most extensively grown and used vegetables in India and it has intrinsic export value. The onion crop has succumbed to the aberrant weather conditions significantly during 1998 and recently in 2005. Abnormally high temperatures during early parts of 1998 followed by excessive rains during 1998 kharif season were the culprit for spiraling of the prices during 1998. On the contrary, it was excessive rains that caused damage to the crop during kharif 2005. Such damage can occur not only to onion but also to many other economically important agricultural commodities thus unbalancing our economy. Hence, a critical analysis of such events is essential to understand and arm ourselves with knowledge to overcome such situations and minimize losses to essential crop commodities.

It is timely that under the guidance of the Natural Resource Management Division of the Indian Council of Agricultural Research, Central Research Institute for Dryland Agriculture, Hyderabad, has taken up a multidisciplinary and multi-institutional study to critically analyse the role of excessive rainfall on yield of onions with short- and long-term recommendations to face such situations in future. The analysis that has been undertaken is brought out in the form of this informative bulletin **"Impact of excess rains on yield, market availability and prices of onion"** which is expected to be highly beneficial to a wide range of stake-holders.

I congratulate the authors for their timely effort.

(Dr. Mangala Rai)
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January 23, 2006

Preface

Crop production is risk prone and strongly dependent on the vagaries of weather. For the year 2002 meteorology centre at Pune reported 670 disastrous events of heavy rains, lightening, thunderstorm, hailstorm, floods, heat wave, squall, cold wave, dust storm, drought, snowfall, gale and cyclonic storm all over India. Excessive deviations or abnormalities in weather could therefore create fluctuations in productivity and production. When the commodity affected is a widely and daily consumed item like onion, the adverse impact on producers and consumers generate socio-economic ripples. This is what happened with onion production and prices in 1998 and 2005. During both the years, the onion production suffered mainly due to the abnormalities in the monsoon behaviour. This calls upon both short and long term pro-active mitigative measures to minimize similar happenings in future. A deep understanding of production and marketing of onion and how these are influenced by weather is critical to formulate proactive strategies. It is with this intention that we made an attempt to put together an analysis of effects of abnormal weather that prevailed during 2005 on production and marketing of onion. This is a collective effort of three institutes, CRIDA, NRCOG and NHRDF with initiation and overall guidance from the Natural Resource Management division of ICAR. We hope this compilation will be useful in devising measures for minimizing the undesirable effects on onion production and marketing.

We sincerely thank Dr. Mangala Rai, Secretary, DARE and Director General, ICAR for his support and guidance throughout this effort. This compilation also drew heavily from the discussions with many researchers, resource persons, officials and farmers concerned with production and marketing of onion in Maharashtra. My co-authors join me in conveying our gratitude to all of them.

(J.S. Samra)
Deputy Director General (NRM)
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January 23, 2006

Contents

Executive Summary

Onions have an extensive culinary, dietary, therapeutic, trading, income and employment generation value. The three main seasons of *kharif* (monsoon), late *kharif* and *rabi* (winter) contribute 15%, 15% and 70%, respectively, to the total onion production in India. India produced around 5.95 million metric tons of onion from 0.44 million ha in 2004 and is the 2nd largest onion producer in the world after China (FAO, 2004). The per hectare productivity ranges from 7.36 tons to 20.00 tons with a mean yield of 12.78 tons and Maharashtra contributes about 30% of India's total production.

Excessive rains, humidity, temperature, pests and disease are critical factors of risk to onion cultivation. Such adverse conditions prevailed during the early part of the monsoon season of 2005. Farmers reported extensive damages due to twister and purple blotch disease induced by delayed heavy rainfall in 2005. In addition to adverse weather, during post-harvest period, lack of dormancy in bulbs, pest- and disease-infestation, leads to excessive storage losses in onion and is a major concern of economic viability. Besides fungal diseases in *kharif* season, stored bulbs were also sprouted due to high humidity, resulting in to less availability.

The present report analyses the main environmental, social and economic factors that influenced onion cultivation with specific attention to the 2005 crop season, with a comparison to the onion crisis experienced during 1998. The cumulative rainfall received during 1998 and 2005, was 734 and 728 mm, respectively as against long-term average annual rainfall of 567 mm and is 29.45 and 28.39% higher, respectively. The monsoon season rainfall from July to October in 1998 and 2005 was excess by 55.95 and 27.44%, respectively, as compared to long-term average, which signifies that the damage due to excess rainfall was significantly higher in 1998. This is reflected in crop loss also as there was 50-80% and 10-15% damage in 1998 and 2005, respectively. In 2005, nurseries were re-sown 2-3 times and purple blotch and twister diseases triggered by high rainfall, humidity and temperature caused major loss. Both in 1998 and 2005, due to crop damage, the prices of onions spiraled in the retail markets. In Lasalgaon market of Maharashtra during 1998, the prices rose to Rs.26.32 per kg.

Similarly, in 2005, the prices in retail markets shot up to Rs. 22.50 per kg.

To minimize such weather induced damages and stabilize the onion yields, crop-growing areas in all states must be divided into different production zones based on growing periods. Zone-specific genotypes and agronomic practices, which are cost-effective and easy to adopt should be developed. Short-day genotypes with dormancy to in-situ sprouting may be evolved. Improved crop husbandry practices such as raised bed system, ridge-furrow system to improved drainage, crop rotation may be promoted to reduce losses due to excessive soil moisture and also diseases incited by pathogens during spells of water logging. Integrated nutrient-, pest- and energy-management packages should be developed and refined to encourage farmers to use biopesticides, organic sources of nutrition and post-harvest processing. Custom-hiring centres for farm equipment may be promoted to increase the utilization of farm machinery in field operations. Regular training of the farmers and trainers in improved crop management practices is essential.

Robust agro-advisories should be provided timely to the farmers by utilizing recent revolution in information technology for effective diagnosis and management of biotic and abiotic stresses and enhanced productivity. Based on long period rainfall data, the length of safe growing period has to be calculated for all the production zones and the possible extent and duration of humid period should be analyzed to plan timely field operations. Analysis of weekly water balance to identify surplus and deficit periods of moisture, which can critically influence the onion production, should be identified for strategic deployment of suitable genotypes and crop planning.

By adopting seed village concept, the seed replacement rate can be improved and also pest, disease and water logging resistant varieties could be promoted in all production zones thereby enhancing the area under high yielding varieties with enhanced shelf-life. Creation of medium-term storage facilities for onion seed will help in timely availability of quality onion seed. Promising NGOs should be encouraged to participate in breeder seed multiplication programme through revolving fund scheme.

Cost-effective method for curing of onion in *kharif* harvest caught in un-seasonal rains at the time of harvest should be developed. Also, solar energy may be tapped for drying 'bulbs' in storehouses especially in northern and North-eastern states. About 15-20% losses occur during harvesting, processing, and marketing. During storage, the losses may be up to 40%. To reduce these losses, developing suitable cultivars, mechanization in harvesting, timely processing, grading and curing is essential.

The markets follow different methods across the Country such as open auction, under cover, tender and open agreement system. In all the systems, the role of government nominees, especially NAFED, should be proactive to protect the interest of both producer and trader to strike a balance. A market intelligence system should be in place for assessing the actual market trends, developing marketing strategies and develop crop acreage plans for the subsequent seasons. Marketing and transportation and export policies should be improved through integrated marketing systems. A contract farming system may also help farmers to produce onions of the required grade and quality. The export houses can use the same platform to meet the export demands. A minimum support price for onions could avoid huge deviations in the prices of onions during the periods of glut and deficit. During the survey, the farmers responded for a support price of at least Rs. 500/- per quintal. Considering the cost of production and B:C ratios, a minimum support price of Rs. 350/- per quintal could be reasonable. Incentives for processing industries in production zones should be encouraged to avoid glut of the markets with the fresh produce and also the surplus produce is processed for value addition.

1. Introduction

Onion among the vegetables does not only adorn the table but also enriches health of the people. The importance of onion in Indian food preparations/culinary has been recognized from ancient times and is considered essential for a balanced diet. It is also a useful feed for cattle and poultry. It originated somewhere in the middle Asian or the Mediterranean regions and is variously known as *piaj* (Hindi), *kanda* (Marathi), *dungri, kanda* (Gujarati), *vulli* (Telugu), *ulli* (Oriya), *erangayam* (Tamil), *eerulli* (Malayalam), and *neerulli, eerulli* (Kannada), etc. Apart from its extensive culinary usage, onions also have therapeutic value. Onions are used as salad and are processed in various ways in curries, fried, boiled, baked, soup making and pickles. These are also dehydrated to add value in the form of flakes, powders and other products for use as spice. Oil and pectin are extracted from onions. Dropsy, kidney, heart, liver, diabetes, tuberculosis are some of the major diseases which are cured by regular consumption of onion. Onion bulbs with common salt are used as a domestic remedy for colic and scurvy. Mixed with mustard oil in equal proportion, it is a good applicant in rheumatic pain and other inflammatory swellings.

India produced around 5.95 million metric tons of onion from 0.44 million ha in 2004 and is the 2nd largest onion producer in the world after China (FAO, 2004). In the last two decades the yields of onion in India have doubled. However, the per hectare productivity ranges from 7.36 tons to 20.00 tons with a mean 12.78 tons as against the highest productivity of 56.67 tons in Netherlands. The major onion growing states in India are Maharashtra, Orissa, Bihar, Andhra Pradesh, Karnataka, Tamil Nadu, Rajasthan, Haryana, and Madhya Pradesh and the production details in these states are given in annexure 1. The share of Maharashtra in the total onion production of the Country is around 30%, producing around 1.2 million metric tons annually (Annexure 2). Within Maharashtra, Nashik district contributes 35 to 40 % of the State's production. The other major onion producing districts of Maharashtra are Pune, Ahmednagar, Satara, Sholapur and Dhulia. Nashik is the biggest onion market of the country, which normally controls and regulates the onion price and supply.

The onion crop is profitable but also highly risky due to steep decline in prices during glut in the market. Hence, the researchers, administrators and policy planners should focus on crop improvement, proper regulation of marketing, export policies and developing infrastructure for processing and value addition to improve overall profitability of onion production systems.

2. Objective of this Survey and Methodology

The objective of this study was to assess the impact of the excess rains on onion crop prospects, market availability and prices and suggest remedial measures to manage similar unusual weather situations.

To assess the impact, various steps were followed. The weather data of various onion production locations from 1998 to 2005 was collected and analyzed. The secondary data on area, production, market arrivals, and prices were collected for further analysis. Information on diseases that damaged the crop during this period was also collected. In addition, detailed interactive discussions were held with research and development organizations namely National Horticultural Research and Development Foundation, Nashik, National Research Centre for Onion and Garlic, Rajgurunagar, Onion and Grapes Research Station (MPKV), Pimpalgaon, and Agricultural Research Station (MPKV), Niphad. Further, a rapid rural appraisal survey was conducted to get the primary data on farm level practices, feed back from NRCO&G adopted farmers and local markets (Fig 1).

Fig. 1. A. Rapid rural appraisal with onion farmers in Chandwad market; B. Following the marketing system in Chandwad; C. Visit to Onion and Grapes Research Centre; D. Visit to ARS, Niphad; E. Discussion of CRIDA survey team with NRCO&G scientists; F. Rapid rural appraisal with onion farmers in Yeola block; G. Discussion of CRIDA survey team with NHRDF scientists; H. Field visit near Pimpalgaon

3. Onion Cultivation

Onions are cultivated in three distinct seasons across the country namely *kharif*, late *kharif* and *rabi*/summer. In some parts of the Country, early *kharif* is also practiced. The seasons followed in different parts of the country are given in table 1. In Maharashtra, the contribution of *kharif*, late *kharif* and *rabi* to total production is 20%, 35-40% and 40-45%, respectively. The details of agronomy of onion are given in Annexure 4.

The development of varieties suited to the *kharif* season over the years has brought about a revolution in onion production in the country. Further strategy for its production all through the year has also been worked out extensively. While *rabi* onion harvested during April to June can be kept up to October for usage, the requirement from October-April is met by its *kharif* season production. Among the released varieties of onion, farmers extensively use only a few varieties (Table 2). The reason for non-adoption of other genotypes is either they are not suitable to the farmers' conditions or sufficient breeder seed is not available for their propagation.

Table 1. Sowing, Transplanting and Harvesting Time in different Areas

Seasons	Time of Sowing	Time of Transplanting	Time of Harvesting
Maharashtra & some parts of Gujarat			
Kharif (Monsoon)	May - June	July - Aug	Oct - Dec
Early *rabi* or late *kharif*	Aug - Sept.	Oct - Nov	Jan - Mar
Rabi (Winter)	Oct - Nov	Dec - Jan	Apr - May
TamilNadu, Karnataka & Andhra Pradesh			
Early *kharif*	Feb - Apr	Apr - June	July - Sept
Kharif (Monsoon)	May - June	July - Aug	Oct - Dec
Rabi (Winter)	Sept - Oct	Nov - Dec	Mar - Apr
Rajasthan, Haryana, Punjab, Uttar Pradesh and Bihar			
Kharif (Monsoon)	May - June	July - Aug	Nov - Dec
Rabi (Suumer)	Oct - Nov	Dec - Jan	May - June
West Bengal and Orissa			
Kharif (Monsoon)	June - July	Aug - Sept	Nov - Dec
Late *kharif* (Monsoon)	Aug - Sept	Oct - Nov	Feb - Mar
Hills			
Rabi (Suumer)	Sept - Oct	Oct - Nov	June - July
Summer (long day type)	Nov - Dec	Feb - Mar	Aug - Oct

Table 2. List of onion varieties released so far by various agencies

Organization	Onion variety
Agrl. Dept. (MS)	**N 2-4-1** (R), **N-53,** N 257-9-1 (W)
MPKV, Rahuri	**Basawant 780** (R), Phule Safed (W), Phule Suwarna (Y)
IARI, New Delhi	**Pusa Red** (R), Pusa White Flat (W), Pusa White Round (W), Pusa Ratnar (R) Pusa Madhavi (R)
IIHR, Bangalore	Arka Niketan (R), Arka Kalyan (R) Arka Bindu (R), Arka Pragati (R), F1 hybrids, Arka Lalima (R), Arka Kirtiman (W), Arka Pitamber (Y)
HAU, Hisar	Hisar II (R)
NHRDF, Nashik	**AFDR (R), AFLR (R)**
VPKAS, Almora	VL 1 (R), VL 3 (R)
RAU, Rajasthan	Udaipur 101 (R), Udaipur 102 (W), Udaipur 103 (W)
CSAUAT, Kanpur	Kalyanpur Red Round (R)
PAU, Ludhiana	Punjab Selection (R), Punjab Red Round (R), S 48 (W)
TNAU, Coimbatore	Onion Multiplier CO-1 (R), CO-2 (R), CO-3 (R), CO-4 (R)

R = Red, W = White, Y = Yellow

Varieties shown in bold letters are some common varieties grown by the farmers.

Agro-meteorology of Onion

The onion crop can withstand cold but sensitive to heat especially at bulb formation stage. The cardinal temperatures for optimum seedling growth, vegetative growth, before bulbing, and bulb development are 20-25, 13-24, 15-21 and 20-25°C, respectively. Very low temperature at bulb development stage favours bolting. Sudden rise in temperature results in early maturity of the crop in *rabi* season thereby reducing bulb size.

Each onion "ring" is called a bulb scale in botanical terminology. Onion growth and development could be described under five growth stages namely germination, leaf growth, bulbing or bulb initiation, bulb growth and maturation. The duration of these five stages vary for short-day, intermediate and long day types. **For all the genotypes, bulb initiation- and bulb growth-phases are sensitive to both moisture deficit - as well as excessive moisture conditions.** During early *kharif*, *kharif* and late *kharif* season short-day type varieties are preferred. They have a higher concentration of water as against to solid fiber content obtained in *rabi* and hence they do not store well and should be consumed quickly. Further, rainy weather during vegetative phase creates favourable conditions for purple blotch and stemphylium blight - pathogens in the *kharif* grown onion crop and leads to poor bulb development.

Almost all the varieties grown in the plains of India are short day varieties excepting for varieties like Spanish Brown and Early Lockeyer Brown, which are long day varieties. *Kharif* onion varieties require day length of 10-11 hours whereas *rabi* varieties require relatively higher temperature and 12-13 hours day length. Long day varieties do not bulb under short day whereas short day varieties if planted under long day will develop bulbs. Day length and temperatures thus significantly influence the performance of a given genotype in a region. Other factors being equal, onions bulbs develop more quickly under warm than at cool temperatures. Temperature thus is more important than the length of day in seed stalk development.

4. Analysis of Impact of Excess Rains

Excessive rains adversely affect the onion crop. Depending on the time of occurrence, rains can cause considerable damage to nursery and main crop. During *kharif* seasons of 2005 and 1998, onion crop was extensively damaged due to the receipt of heavy rains. During *kharif* 1998, the rains continued through out the crop season causing damage to *kharif* and late *kharif* crops and nursery of *rabi* crop leading to severe shortage of onions in the Country. In *kharif* 2005, initially, due to delay in the onset of the monsoon, sowing of *kharif* crop was delayed. Subsequently, the standing *kharif* crop was damaged due to excess rains leading to poor bulb formation coupled with infestation by diseases. The nursery of late *kharif* was damaged and was formers were forced to resow 2-3 times.

The impact of heavy rains on onion crop during 2005 is discussed under three heads viz. impact on yield, influence on crop health and economic consequences.

Impact on Yield

The major Onion growing areas in the country are the Central and Western Maharastra, North Karnataka and North Western Telangana located in the hot, moist semi-arid eco-sub region. In Maharashtra, the districts falling under this subzone are Nashik, Dhule, Aurangabad, Jalna, Nanded, Parbhani, Latur, Northern hilly parts of Ahamdnagar, and western parts of Jalgoan (Fig. 2). Predominantly onion growing talukas in Nashik district are shown in Fig. 3. The agro-climate of the above sub-region is characterized with dry summers and mild winters. The mean maximum temperature ranges from 26-27°C in coldest month to 38-41°C during the hottest month and the minimum of 15-16°C during December and January to 20-22°C during April-May. The mean annual rainfall vary from 700-1000 mm which satisfy 44-53 per cent of the

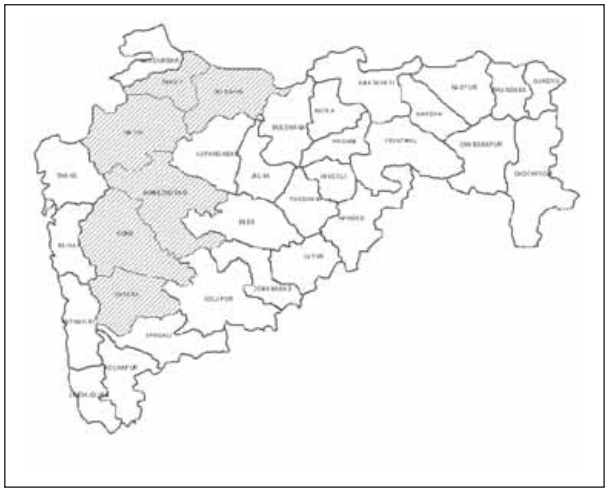


Fig 2. Distribution of onion crop in Maharashtra (shaded areas indicate 0.1 million ha.)

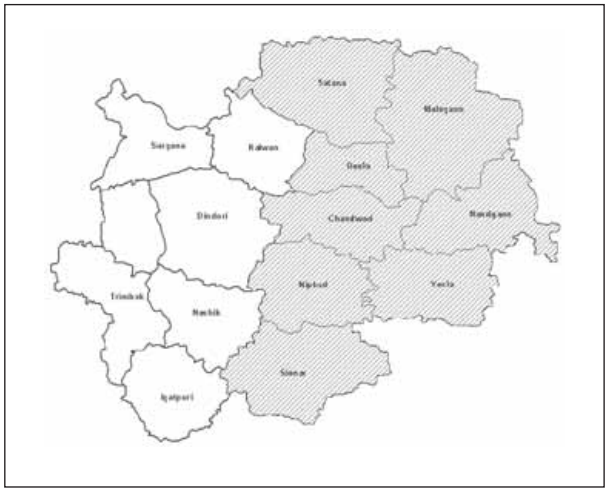


Fig 3. Distribution of onion crop in Nashik district

mean annual potential evapotranspiration (PET) of 1700-1900 mm. The area lies on the leeward side of Sahyadri range comprising rain shadow area of Southwest monsoon. Hence, the erratic summer monsoon experienced by this region sets in last part of June and extends till the 2nd week of October. The beginning of rainy season is often associated with stormy cloudbursts and ending is abrupt with moderately high potential evapotranspiration demand. The monsoon seasonal (June-Sept.) rainfall covers about 88 per cent of the mean annual rainfall received in this area. The soils of the sub-region are shallow to medium and loamy to clayey black soils (medium and deep clayey black soils as inclusions), medium to high available water holding capacity with an average length of growing period of 120-150 days.

Abnormal weather events such as torrential rains, rise/fall in temperatures have profound influence on the performance of the crop. During the crop seasons of *rabi* 1997, *kharif* 1998 and *kharif* 2005, onion crop was damaged due to abnormal temperatures and rainfall. These events were analyzed critically and discussed below.

Length of Growing Period

Onions are grown during three seasons viz. *kharif* (June to October), late *kharif* (September to February) and *rabi* (December to April). The proportionate area sown under different seasons in 2004-05 is shown in fig 4.

The length of growing period or the moisture availability period is one of the important

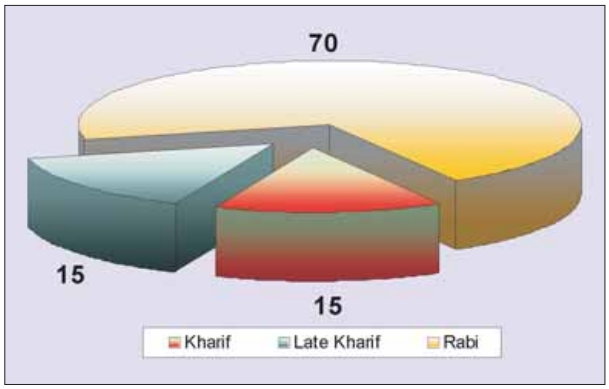


Fig. 4. Percent area under onion in different seasons of 2004-05 in India

parameters to assess the climatic suitability of a crop to attain maturity within available growing period for the given agro-climatic region. The length of growing periods have been calculated based on 8 years data for 9 locations in Nashik district where the *kharif* and late *kharif* onions are predominant crops. The length of growing period values across 9 stations are presented in table 3.

Table 3. Length of Growing Period (moisture availability) in weeks at different stations (Nashik)

Station	Mean	Max	Min	SD	CV (%)
Baglan	17.6	24	8	4.9	28
Chandwad	18.0	22	8	4.4	25
Devali	16.1	22	9	5.3	33
Dindori	20.6	25	17	2.7	13
Malegaon	15.4	22	8	4.9	32
Nandgaon	15.6	26	8	7.1	46
Niphad	20.0	25	15	3.3	16
Sinnar	21.1	24	15	2.9	14
Yevla	18.4	24	9	5.5	30

The men length of growing period of 109 days was noticed in Malegaon, which is barely sufficient for short-day types of *kharif* onions. However, in other locations such as Sinnar, the length of growing period (147 days) is fairly sufficient to complete the long life cycle of *kharif* crop. Irrespective of the length of growing period, the farmers across these stations are growing mostly local types, thus makimg them vulnerable to extreme weather events. The released cultivars of onions hence should be tested for their suitability based on their stagewise water requirement and periods of adequate moisture availability during the crop growing period. Hence, a critical analysis is required to identify stress periods for providing supplemental irrigation especially for late *kharif* crop to grow better genotypes with higher productivity and longer shelf-life.

Rainfall Analysis of Selected Blocks of Nashik District

The rainfall pattern and rainy days across 9 locations of predominant *kharif* onion growing regions of Nashik district were analyzed (Table 4). At Chandwad, Dindori, Niphad and Sinnar, the rainy days are gradually increasing with increase in rainfall over years thus enhancing the length of growing period. On the other hand, at other locations, though there was a significant increase in quantum of rainfall, there was no corresponding increase in rainy days resulting in stagnation length of growing period.

Table 4. Rainfall (mm) and rainy days (#) across 9 *kharif* onion locations of Nashik district

Centre	Parameter/year	1998	1999	2000	2001	2002	2003	2004	2005
Baglan	Rainfall (mm)	NA	211	292	338	580	500	638	567
	Rainy days #	NA	21	15	26	30	25	36	33
Chandwad	Rainfall (mm)	538	310	459	398	698	364	630	629
	Rainy days #	39	33	18	32	30	27	43	45
Devali	Rainfall (mm)	554	268	370	356	367	299	347	452
	Rainy days #	45	24	22	22	27	23	30	29
Dindori	Rainfall (mm)	584	464	433	415	867	735	953	760
	Rainy days	43	30	33	35	36	43	48	51
Malegaon	Rainfall (mm)	480	468	373	310	536	360	527	410
	Rainy days #	33	34	23	24	29	20	33	30
Nandgaon	Rainfall (mm)	736	543	692	307	553	323	403	402
	Rainy days	39	34	24	24	29	25	36	36
Niphad	Rainfall (mm)	595	631	487	398	672	491	786	876
	Rainy days #	40	41	37	30	32	25	43	45
Sinner	Rainfall (mm)	587	402	492	287	436	617	563	625
	Rainy days #	36	28	30	30	32	28	39	43
Yeola	Rainfall (mm)	508	417	492	373	380	286	626	433
	Rainy days #	41	27	30	32	25	25	37	35

The deviations of *kharif* season weekly rainfall patterns of 1998 and 2005 across 6 predominantly *kharif* onion growing regions of Nashik district is shown in fig. 5. During second week of June to second week of July, the deviations were significantly high during *kharif* 2005 as compared to *kharif* 1998 except in Nandgaon where 1998 deviation was more as compared to 2005. However, the magnitude of damage to the crop was significantly more during *kharif* 1998 due to the prolonged spell of excess rainfall during last week of August to third week of October, which coincided with bulb initiation and bulb development phenophases of main crops of *kharif* and late *kharif* as well as nursery stages of late *kharif* and *rabi* crops.

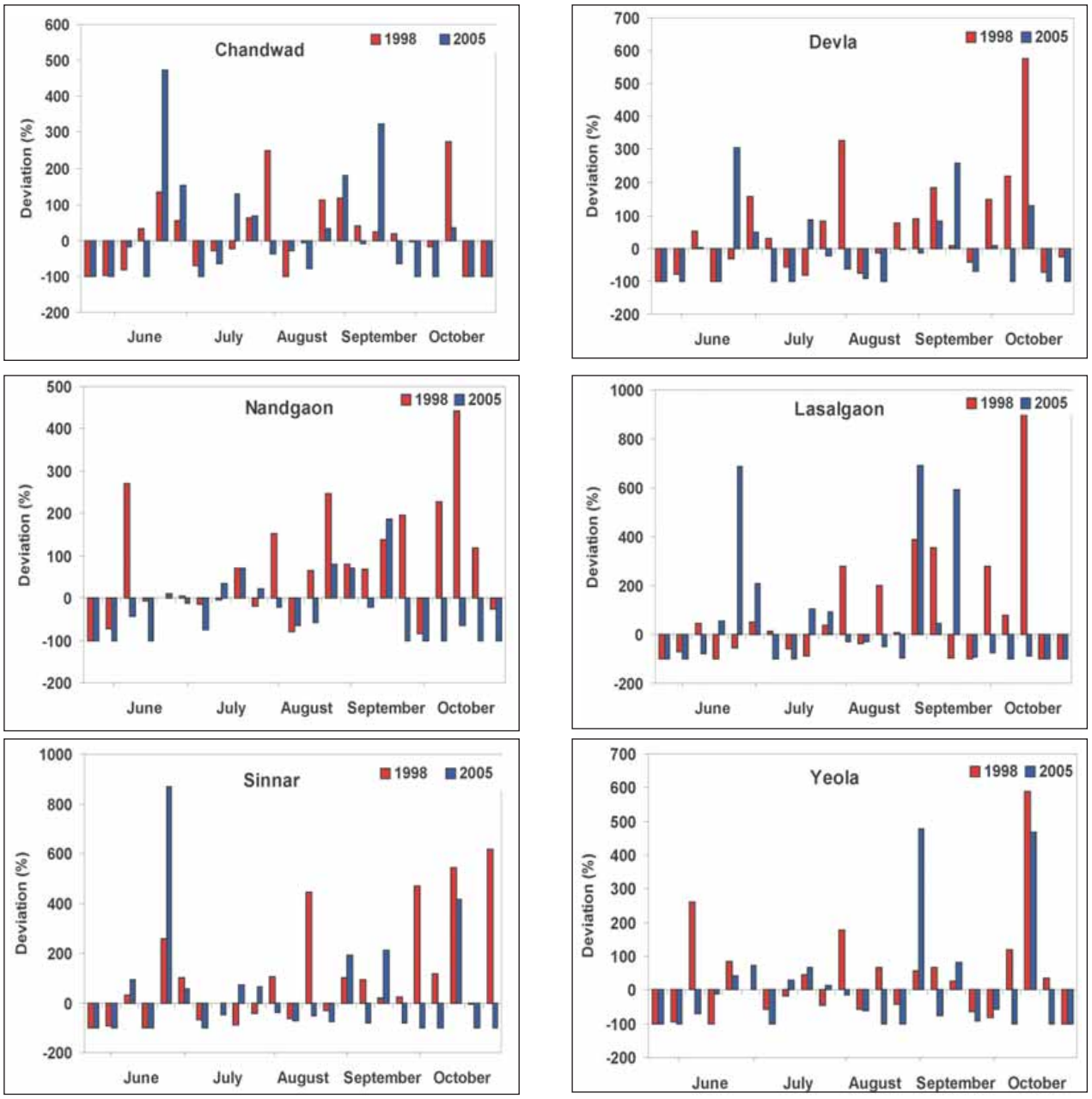


Fig. 5. Deviations of rainfall at selected stations of Nashik district during 1998 and 2005 as against normal rainfall

Wet- and Dry-Spells

The wet- and dry-spells during the growing period in the district have a significant impact on the crop growth, health and yield. A 15 days dry spell conginial for pest infestation in onion crop whereas 2-3 days continuous wet spell can damage the bulb of onion and also trigger the diseases. Hence, the probability of occurrence of wet- and dry-spells of different durations was calculated for different locations in Nashik district and are shown in tables 5 and 6. The probability of occurrence of dry spell of greater than 10 day period is very less at all the locations during the period June - September which indicates about the assured rainfall events during the monsoon period at these locations, a favourable growing environment for onion crop.

The probability of occurrence of wet spells (continuous days with >5mm rainfall per day) for 2 or more days is high during August and September across the locations. These wet spells are critical to bulb initiation and bulb development phases of *kharif* onion crop. The wet spells of 4 days and above varied widely from location to location and also in their time of occurrence.

Table 5. The probability of occurrence of dryspells of different durations

Station	Month	Probability (%)					
		>10 days	>11 days	>12 days	>13 days	>14 days	>15 days
Yeola	July	7	7	4	4	3	1
	August	5	3	2	1	1	1
	September	4	3	3	3	3	3
Chandwad	July	7	7	5	4	4	3
	August	8	4	1	1	1	1
	September	4	4	4	4	1	1
Baglan	July	7	7	3	2	2	2
	August	8	8	8	8	6	2
	September	5	5	3	3	3	3
Dindori	July	3	3	3	1	0	0
	August	0	0	0	0	0	0
	September	8	8	8	8	8	7
Devali	July	7	7	4	4	4	4
	August	8	7	4	4	1	1
	September	5	4	4	3	1	1
Nandgaon	July	7	5	4	4	4	1
	August	5	4	2	1	0	0
	September	7	4	3	3	3	3
Malagaon	July	6	6	3	3	3	3
	August	7	7	3	1	1	1
	September	6	5	5	5	5	5
Niphad	June	6	5	4	4	1	1
	July	4	4	4	4	4	4
	August	1	0	0	0	0	0
	September	7	7	7	3	3	1
Sinnar	July	5	5	4	3	3	3
	August	2	1	1	1	0	0
	September	6	6	6	6	5	5

*Continuous period with <2.5 mm rainfall per day

Table 6. The probability of occurrence of wetspells of different durations

Station	Month	Probability (%)			
		>2 days	>3 days	>4 days	>5 days
Yeola	July	12	4	1	0
	August	17	3	1	0
	September	17	5	0	0
Chandwad	July	21	7	3	1
	August	12	3	2	1
	September	15	6	4	0
Baglan	July	17	4	0	0
	August	18	7	2	0
	September	16	8	0	0
Dindori	July	20	13	7	4
	August	15	9	6	2
	September	24	6	3	3
Devali	July	13	3	0	0
	August	10	3	1	0
	September	25	11	3	2
Nandgaon	July	10	4	1	0
	August	17	6	5	3
	September	21	5	1	1
Malagaon	July	10	2	0	0
	August	18	9	4	0
	September	15	8	1	0
Niphad	July	13	7	1	0
	August	14	10	2	0
	September	22	15	7	1
Sinnar	July	15	7	2	0
	August	15	3	3	1
	September	18	6	1	0

*Continuous period with >5 mm rainfall per day

A critical analysis of the onion crop performanc during 1997-98 revealed that the adverse impact on production of onions was due to an abnormal increase in temperature during early part of 1998 that affected the crop prospects of *rabi* 1997 (Fig. 6). During *kharif* 1998 excessive rains continued until December leading to failure of nurseries of *kharif*, late *kharif* and *rabi* crops and damage to the standing crops of *kharif* and late *kharif* 1998 (Fig. 7).

During *rabi* 1997-98 there was a sudden change in the climate all over the country. The temperatures increased sharply (above normal) in March which was not favourable for onion bulb development. Maximum day temperatures continued to remain above normal during the first week of April and again during May (for 3 weeks) resulting in forced maturity. Over all production was thus reduced significantly during *rabi* 1997-98 (3.2 million tons). Bulb size during

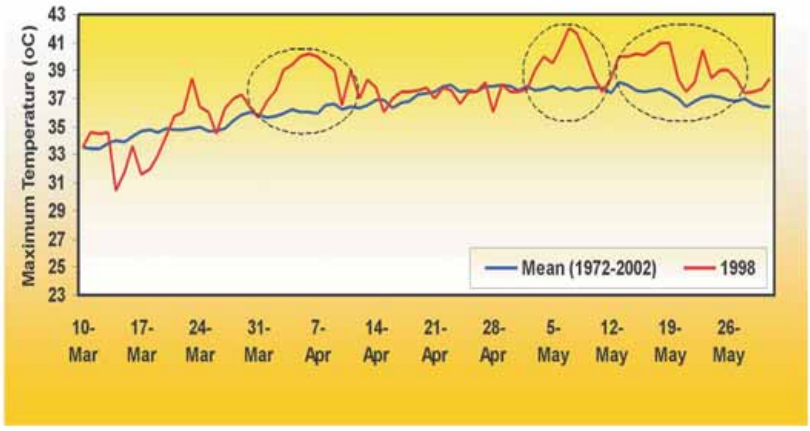


Fig 6. High temperature spells during *rabi* 1997 onion crop season

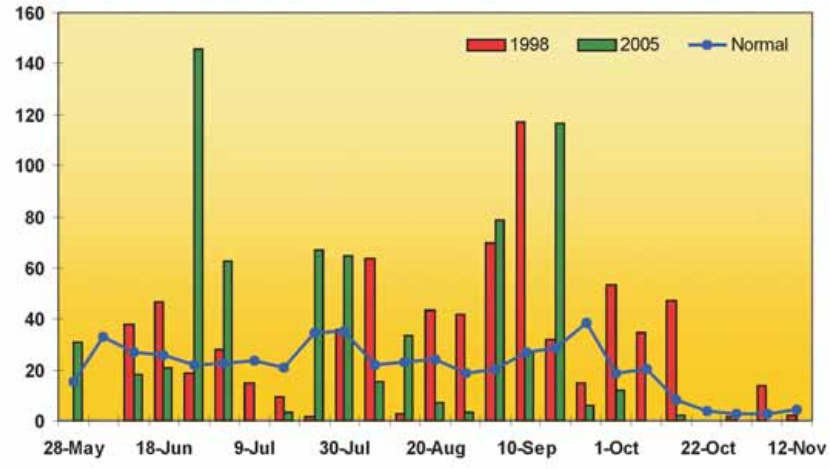


Fig. 7. Rainfall pattern during *kharif* seasons of 1998 and 2005 against normal rainfall

rabi was also reduced considerably. Further these bulbs were not fit for long-term storage. As a result, storage from *rabi* produce - was comparatively less (7-8 lakh tones). As expected, losses in storage also increased to more than 50% due to the force-matured stocks.

Further, during *kharif* 1998 there were continuous rains during the crop growing period which caused severe attack of purple blotch and stemphylium blight diseases affecting the onion crop badly. The total production during *kharif* was also reduced significantly. Late *kharif* crop planting was also delayed due to continuous rains in October. Similarly nursery of *rabi* crop for *rabi* 1998-99 was also damaged. The farmers, however, planted nursery again, which compensated production.

Influence on Crop Health

Generally onion is cultivated as an unirrigated crop. During early *kharif*, *kharif* and late *kharif* seasons, depending on the quantum and distribution of rainfall, the crop is supplemented with 4-5 irrigations. The water requirement of onion is 350-550mm. Uniform distribution of

rainfall can result in good yields of *kharif* crop. However, excessive rainfall will result in warm and high humid conditions, which are congenial for many pathogens that can infect the onion crop.

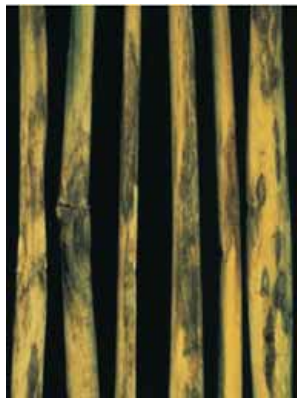
Diseases Observed During *Kharif* 1998 and 2005

In *kharif* 2005, the excess rains exposed the crop to purple blotch, basal rot, twister, onion colletotrichum blight, and brown rot. These diseases have led to considerable yield loss, though exact figures are not yet available. Similarly, during *kharif* 1998, purple blotch and stemphylium blight damaged the crop extensively. The details of major diseases that adversely affect onon production are are given here.

Purple Blotch *(Alternaria porri)*

Purple Blotch causes onion leaves to become blighted and die prematurely resulting in undersized and immature bulbs, thereby reducing yields.

Initial symptoms appear as small, water-soaked, brownish areas on leaves, flower stalks, and floral parts of onions 1-4 days after infection occurs. As the spots enlarge, they assume a zonate appearance and become somewhat sunken and purplish in color. The lesion border is reddish or purple with a yellow halo that extends for some distance above and below the center of the lesion. Lesions may girdle the entire leaf. Onion bulbs may be infected at harvest or later, in storage through the neck or through wounds in the bulb scales. The rot is semi-watery and yellow at first. The color gradually turns wine-red and finally dark brown or black. Diseased bulb tissue gradually dries out and becomes papery.



The destructiveness of the disease varies widely with locality and season. It depends upon how often, and how long dew, fog, or showers keep the onion foliage moist. In poorly drained soils, the incidence is more. The fungus over-winters as 'mycelium' in diseased plant debris and produces spores under favorable conditions in the spring. Purple blotch often follows leaf fleck or lieaf blight caused by Botrytis. The disease could be managed by spraying mancozeb @ 0.25% or carbendazim @ 0.01%.

Basal Rot *(Fusarium oxysporum* f. sp. *cepae)*

Basal rot is a widespread disease of onions. This disease affects onion plants after midseason and continues after harvest as a storage rot. It is particularly troublesome on soils that are continually planted to onions. Decay progresses slowly and often does not become noticeable until bulbs are in storage.

The leaves of affected plants die back rapidly from the tip as plants approach maturity. Affected roots are dark brown, transparent, and hollow. Most of the roots eventually rot off, and in their place a mass of white moldy growth is produced.

The bulbs become soft, and when cut, a semi-watery decay is found advancing from the base of the scales upward. The rot progresses slowly and early infections are often unnoticed at harvest time. Thus, the disease becomes a critical factor in transit and in storage, where the decay may continue until the bulbs are entirely destroyed. Frequently a secondary wet rot will invade the infected plants. Fusarium basal rot is most severe in warm weather with high soil temperatures. The fungus over-winters as 'chlamydospores'. Primary infection takes place through wounds or as a result of infection by other pathogens. Intact tissues may also be invaded. Root maggot injuries are thought to be major entry sites for the fungus. Sound cultural practices such as soil organic amendments, and crop rotation and proper storage conditions reduce the incidence of this disease.

Twister Disease *(Glomerella cingulata)*

Twister disease has been reported recently in India. This disease caused damage to the crop

during *kharif* 2005 too. Infected plants show elongated twisted leaves leading to improper bulb formation. The infected bulbs show blemishing dots on the outer scale, which reduce market value of the bulbs. The disease can be managed by proper curing of the bulbs after harvesting and storing in well-ventilated rooms. The disease could be managed by spraying mancozeb @ 0.25% or carbendazim @ 0.01%.

Colletotrichum Blight *(Colletotrichum gloeosporoides)*

The disease was reported from Maharashtra. The disease resembles onion smudge caused by Colletotrichum circinans. The symptoms appear as pale yellow water soaked lesions, which later cover entire leaf blade. The lesions turn black with the concentric rings at the center of the lesion. The centres of the lesions are slightly raised. Affected leaves shrivel, droop down, and finally wither. Infected seeds and infected plant debris left in the field after harvest serve as inoculum for subsequent plantations. The disease is favoured by moist and warm weather during the reproductive stages. Wet periods of about 12 hours or more favors the occurrence of infection and nutritionally stressed or unhealthy

crops also support the disease incidence and spread. The disease could be managed by spraying mancozeb @ 0.25% or carbendazim @ 0.01%.

Stemphylium Leaf Blight *(Stemphylium vesicarium)*

Initial infections on the leaves and leaf sheaths are small, light yellow to brown, and water-soaked. As the lesions expand, they merge causing extensive blighting of the leaves. Typically, lesions are found in higher numbers on the side of leaves facing the prevailing wind. The centers of lesions turn brown to tan, then dark olive brown, and finally black (due to abundant sporulation by the pathogen). Sometimes fruiting bodies called 'perithecia' may appear in infected tissue as small, black, pinhead-like raised bodies.

This fungus normally invades dead and dying onion tissues. However, severe damage can occur on healthy leaves during warm weather when leaves are wet for more than 24 hours. Infection is usually limited to leaves, and does not extend down to the scales of the bulb. The disease could be managed by spraying mancozeb @ 0.25% or carbendazim @ 0.01%.

Brown Rot *(Erwinia carotovora* pv. *carotovora, Pseudomonas gladioli* pv. *allicola, P. cepacia)*

Brown rot is frequently noticed after harvest during storage. The bacteria enter through wounds in the neck or through feeding wounds of the onion maggot. The bulb scales become water-soaked and pale yellow, causing them to slip off the bulb. The entire bulb becomes soft and frequently develops a very foul smell.

Control can be achieved by harvesting the bulbs after the tops have matured and dried down. Exercise care to avoid bruising during the harvesting. Store the onions at 32 to 36 F at 65 to 70% relative humidity.

Other Probable Diseases

There has been no systematic survey of the predominat onion-growing regions of onion, especially affected by excessive rains. In *kharif* 1998, incidence of purple blotch was reported to be the major disease that caused damage to the crop. However, the humid and warm conditions are also congenial for stemphylium downy mildew, leaf blight, and leaf fleck . The probability of incidence of other diseases could not be ruled out as in our survey, we noticed incidence of botrytis blight in *kharif* 2005. Further, purple blotch and stemphylium blight co-occur if weather conditions are favourable for both pathogens and symptoms of both diseases are very much alike and could easily be mistaken. Hence, identification details of other probable diseases are - provided here.

Botrytis Leaf Blight
(Botrytis squamosa)

Botrytis leaf blight kills foliage and spreads so rapidly that growers gave it the name “blast”. Symptoms of the disease appear first on the oldest leaves as oval whitish or yellowish spots approximately 1-3 mm long, slightly depressed and bordered with a diffuse silver halo. If the leaf is sliced open, it can be seen that the lesions extend through the thickness of the leaf blade. When conditions favor spread, the disease progresses rapidly and numerous lesions appear on each leaf. Foliage may be severely damaged with substantial reductions in yield.

Onions appear to be highly susceptible to leaf blight during the early stages of bulbing. Extended periods of leaf wetness are necessary for infection and the extent of the leaf blight is directly related to the length of time the foliage remains wet. The fungus survives in the soil and on plant refuse as sclerotia. During cool, moist weather sclerotia give rise to airborne spores. These lodge on wet onion foliage, germinate, and enter the plants through wounds.

Botrytis Leaf Fleck
(Botrytis cinerea)

White flecks are found along the length of the leaf and usually have greenish halos. It remains on the surface of the leaf. During prolonged periods of wet weather, the symptoms spread

rapidly. With numerous flecks, the tip of the leaf may die. The most severely infected crop shows a leaf infection level of 0.3% when sampled - early in the season, highlighting how quickly a small (or undetectable) amount of infection can develop into a serious problem. The fungus spread is predominantly via irrigation or rain-splash events.

Downy Mildew
(Peronospora destructor)

Downy mildew is a potentially serious disease of onions particularly when onions are grown under cool, moist, and humid conditions. Infection occurs on leaves > 10 inches in length. Downy mildew may produce local lesions or it may be systemic. Local infections cause partial damage to the crop that appear as pale-green, oval to elongate, slightly sunken lesions on leaves and seed stalks and killing only infected tissues. Systemic infection occurs right from

seedling stage andf kills the infected seedling. The older, plants, outer leaves usually become infected first. Systemically infected plants are stunted and have distorted pale green leaves. Under moist conditions, a fuzzy violet fungal growth develops over the entire leaf surface. Bulbs produced by affected plants are often smaller than normal. In moist weather, these areas may be covered with a fuzzy, pale, purplish growth of ther fungus. Later the whole leaf may turn a dull pale green and then yellow. Affected foliage often breaks over and shrivels.

The fungus over-winters as 'mycelium' in infected onion bulbs left in field after harvest. The fungus may also persist in the soil to infect seedlings planted in the following season. Spores produced during the summer are carried by wind to infect new plants.

The insect-pests that infest onions and their management are given in annexure 5.

Influence on Market Availability

To understand the impact of excessive rains over market availability of onions, a thorough understanding of the economics of onion production, market arrivals, marketing systems and pricing structure need to be understood.

Economics of Onion Production

Onion is an important commercial crop and provides employment at multi levels. The crop receives relatively better attention in terms of nutrition, irrigation and protection from a variety of diseases and pests. As an example, the economics of onion cultivation in Nashik district is presented in detail in Table 7.

Table 7. Cost of cultivation of Onion (Rs/ha)

Item	Cost (Rs.)
Land preparation	2125
Seed	1200
Nursery management	3750
Farm Yard Manure	2500
Fertilizers	3000
Micronutrients	1250
Fungicides	1200
Insecticides	800
Weedicides	520
Irrigation	2460
Human labour	15180
Total	33985
Average yield (tons)	20
Transportation and marketing	4450

Source: NRCOG, Rajagurunagar

The average cost of cultivation amounts to be around Rs. 34,000/ha. With an average yield of 20 tons/ha, the cost of production of onion is about Rs. 1699/tons. If the marketing costs of about Rs. 4450 are added, the farmers' cost of onion at the market yard is about Rs.1922/tons. This is the breakeven price if the farmer is to recover at least the variable costs. If one is to add the fixed costs and risk, the costs would further increase by 20 per cent to Rs.2306/tons. Considering at least a 10 per cent profit margin, the farmer should at least get a price of Rs.2537/ tons. But in reality, not very often farmers get a

price of more than 2000/tons. Many farmers complain that prices fall to as low as Rs.1500/ tons in the times of glut. Hence, farmers are aspiring for price support mechanisms in terms of minimum support prices and market procurement by the government agencies and more liberal exports.

However, it is possible to enhance profitability to some extent if the onions can be stored for selling at a time when the prices are relatively higher. According to a study by the NRCOG, the net profits can be increased from Rs. 155 when onions are sold immediately (in June) to Rs.28,750 when the same onions are sold in October even after accounting for the storage losses and storage costs (Table 8). It is not profitable to store onions beyond October as the storage costs outweigh the price advantage. Such profitability gains arise from the price fluctuations.

Table 8. Economics of storage of *rabi* onion

Quantity stored: 25 tons; Basic value of onions: Rs.57000; Cost of storage: Rs.2500

Period of storage	Costs (Rs)			Storage losses (%)	Net Sale quantity (q)	Sale price (Rs./q)**	Gross income (Rs.)	Profit (Rs.)
	Sorting and packing	Interest on capital	Total					
May	0	0	57000	0	25	228	57000	0
May-June	1875	570	61945#	8	23	270	62100	155
May-July	1875	1140	62515	12	22.8	299	68172	5657
May-Aug	1875	1710	63085	23	19.25	375	72187	9102
May-Sep	3750*	2280	65530	25	18.75	447	83813	18283
May- Oct	3750	2850	66100	30	17.5	542	94850	28750
May-Nov	3750	3420	66170	45	13.75	574	78925	12255
May-Dec	3750	3990	67240	55	11.25	484	54450	-12790

Source: NRCOG, Rajagurunagar

* Two sortings are required for storage beyond August; **12 year average price of Chakan market; # includes storage cost of Rs. 2500

Major Onion Markets in India

Lasalgaon and Pimpalgaon in Nashik in Maharashtra district are the leading onion markets in India. About 40% of the total production of onion in Nashik district arrives to these markets aggregating about 4.5-50 lakh tons annually. Peak period of arrival in this market is December to June (*kharif* produce) when 60% of the total arrivals are received. Chakan and Gultekdi in Pune, Lonand in Satara, Rahuri in Ahmednagar, & Dhule, Malegaon, Yeola, Niphad, Saikheda, Chandwad, Manmad, Dindori and Sinnar in Nashik district are other major assembly markets for Onion in Maharashtra.

With increased production of onion in Ahmednagar district many new market centers have also been in operation from last few years.

Agencies Involved in Onion Marketing

Out of the total onion production in the country, it is estimated that a loss of about 15-20% occurs on various accounts during process of handling after harvesting and in the course of marketing. About 10-15% of total production is exported and used for processing and remaining produce is consumed internally and used as seed material. A number of agencies including producers, commission agents, merchants, wholesalers and cooperatives etc. are involved in the marketing of onions. The cooperatives have been playing a significant role in the marketing of onions particularly after NAFED entry in this trade. There are also some cooperative societies like the HOPCOMS in Karnataka. The mother dairy in Delhi and such other agencies are also helping farmers in marketing their products. Rythu Bazars (urban market places where farmers can sell their produce to consumers directly as in Andhra Pradesh) have also been established for effective marketing of vegetables to benefit growers as well as consumers. Vegetable and Fruit Cooperative Marketing Society, Lasalgaon, Mahuava Taluka Cooperatives Sales Purchase Union, Mahuava and Onifed in Bhavnagar, Gujarat and other such organizations act as commission agents for the sale of their members' produce and thus are indirectly taking part in the marketing of onions. The onion growers' cooperative societies in Pune and Ahmednagar district of Maharashtra are also taking up activities on onion products, marketing and storage.

In order to avoid gluts in the major producing areas and to provide onion at reasonable prices to consumers throughout the year in major consuming market, the recent trend in marketing has been a mixture of large scale purchase by Government agencies from major producing areas under support price or 'market intervention operation' and also on commercial basis. Export of onion on regular basis also helps growers in getting remunerative prices. NAFED endeavors to protect the interests of consumers by arranging supply of onions at reasonable prices during period of shortages through maintenance of buffer stock. The Andhra Pradesh government has also constructed onion godowns to maintain buffer stocks to regulate the onion supplies.

Marketing Practices

Onions are marketed in different assembly and distributing markets in the country through (i) open auction system (Lasalgaon, Chandwad, Pimpalgaon (B), Saikheda, Niphad, Manmad and Sinnar, Chakan, Pune, and Lonand in Maharashtra; Mysore, Bellary and Hubli in Karnataka); (ii) under cover or hatha system (Vashi, Mumbai); (iii) tender system (Mysore, Bellary and Hubli in Karnataka) and (iv) open agreement system. In the markets of Mysore, Bellary and Hubli in Karnataka, however, for opening bid, under cover system is followed. The producers may either send their produce to commission agents (who have their shops inside

or outside the market) who arrange the sale in the market or they may themselves bring the produce to the commission agents' premise for sale. After purchasing from the agents the wholesaler and exporters arrange sorting and grading of the onion, pack them in gunny bags and dispatch to different distributing or consuming markets. From assembly markets (such as Lasalgaon in Maharashtra, Mahuva in Gujarat, Kurnool in A.P. and Bellary in Karnataka) onions are moved further to the distributing or consuming centers all over the country. City markets like Calcutta, Mumbai, Delhi, Guhawati, Bangalore, Hyderabad and Kanpur etc. are major consuming centers of onions and they depend on one or more assembly markets for their supplies.

Procurement at Different Markets

In Nashik district, procurement of onion is regularly made at Lasalgaon, Pimpalgaon and Saikheda centers through out the year. Other markets like Manmad, Yeola, Niphad, Chandwad, Malegaon, Sinnar and Didori are also covered according to production and requirement. In areas, where the produce inflow is mainly from *kharif* and late *kharif* seasons, the market arrivals virtually freeze after April. Chakan, Gultekadi, Lonand are regular markets while Faltan and Dahiwadi are seasonal markets, because production of onion is not round the year and storage is also not much in these areas. An open marketing system followed in Chandwad market is shown in fig 8.

Fig 8.A typical market opening (Chandwad) ceremony for kharif produce of onion (Open auction system)

The Production and Marketing Seasons

The production seasons and arrivals lead to a typical situation where in the prices tend to peak during September-November and fall during January-March every year (Fig 9). Generally, the onion storage gets emptied by around August-September depending on the previous *rabi* production, the availability of storage structures and export demand. There will be a 'scarcity' period during October-November after which the *kharif* onions arrive in the market. The late *kharif* production arrives from January onwards. Almost all of the *kharif* production and a significant part of late *kharif* onions are made available in the market without getting held in storage. It is only the *rabi* onions which are stored as buffer and get released into the market continually till the stocks last.

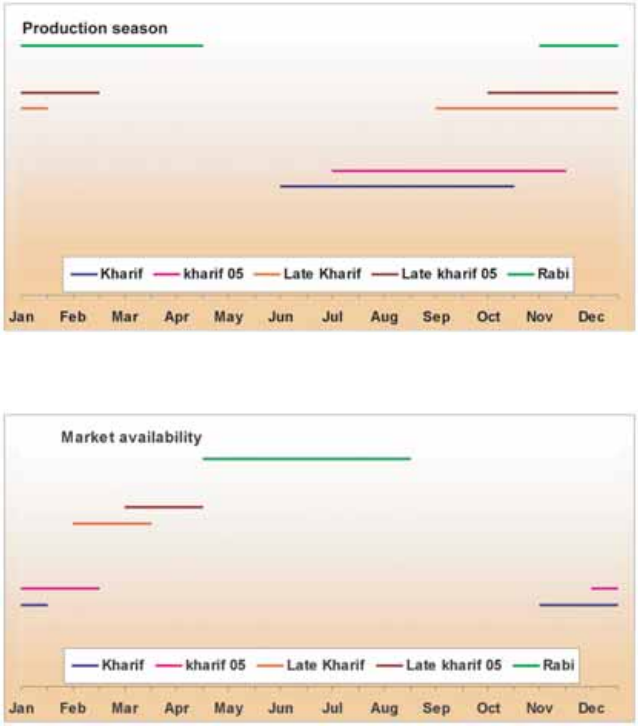


Fig 9. Cropping seasons and market availability of onions in India

Market Arrivals and Prices During 2005-06

The arrivals of onions in different markets along with the modal prices are presented in figure 10 and 11. The retail prices of onions in four metros during 2005 show that there was a sudden increase in the prices of the onions during the September to November (fig. 10). This price increase is due to the huge gap between demand and supply that was created due to shortfall in supply from southern states where early *kharif* crop failed and the main *kharif* crop of Maharashtra was damaged due to continuous rains. The trends in monthly prices in different markets exemplify the seasonal production nature of onions. Steep increases in the prices associated with marked declines in the arrivals can be seen in different markets because of the changes in the production environment. The fall in arrivals in 2005 compared to 2004 was due to reduced productivity as well as the delayed sowings. A further comparison of situation in 2005-06 with that in 2004-05 will highlight these issues. The daily arrivals and modal prices of onions for the critical period of September-November for some important markets are given in the figure 11. In all the markets, the 2005 prices are much higher than the 2004 prices for the September-November period. For example in Nashik market, the average price was fluctuating within the range of Rs. 400-600/quintal during 2004. This price was observed to be about Rs. 1000/quintal during 2005 for this period. Similarly, in Delhi market the average price, which was never more than Rs. 700/quintal during 2004, increased to more than Rs.1000/quintal during 2005. It becomes clear from the figure 11 that there were conspicuous falls in the quantity of onions brought to different markets during September-November 2005 compared to those during 2004-05. As a result, the prices have shot up. Similar conspicuous differences were seen in the Kurnool, Hyderabad and Hubli markets also which largely thrive on the *kharif* onions. Till July 2005, the monthly modal prices for 2005 were significantly lower than the corresponding 2004 prices. In Hubli market, the onion prices rose sharply in September to Rs. 800 per quintal (Fig 11) where as in August 2005 the price was Rs. 678 per quintal and in August 2004 the price was Rs. 465 per quintal. In Chakan market, more quantities of onions arrived in 2005 than in 2004 till the month of May. Subsequently, there was a

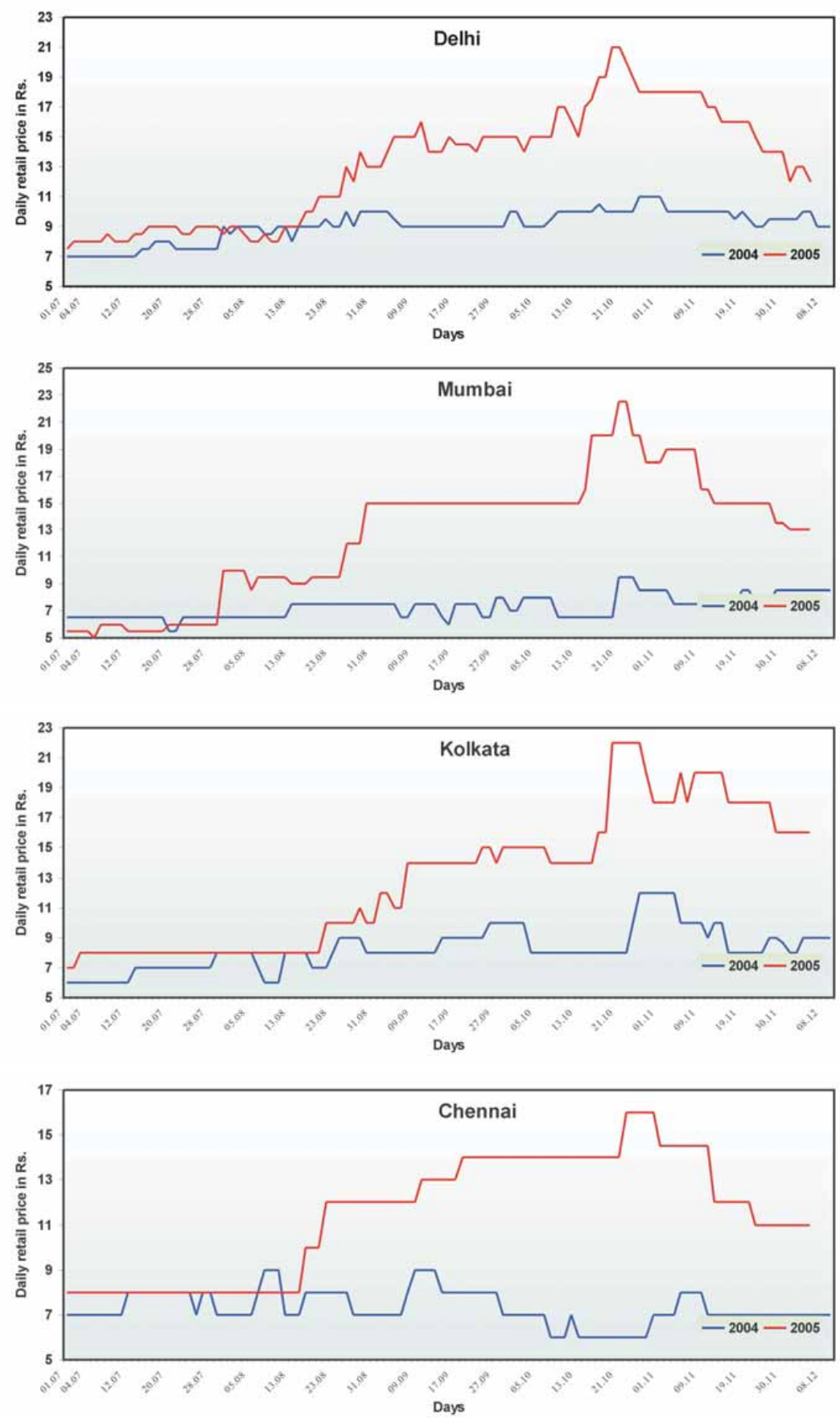


Fig. 10. Retail prices of onions across metro markets during 2004 and 2005

sharp fall in the arrivals and thereby leading to rise in prices. This trend continued in September too. In the Nashik market, which is a much bigger onion market in India, the price of onion in August and September 2005 was about Rs 505 and 844 per quintal, respectively, compared to Rs.368 and 372/quintal in 2004. In the metropolitan market like Hyderabad, the prices in September 2005 were almost doubled compared to the price in September 2004. Thus, the prices have shot up steeply from September 2005 onwards in most of the markets.

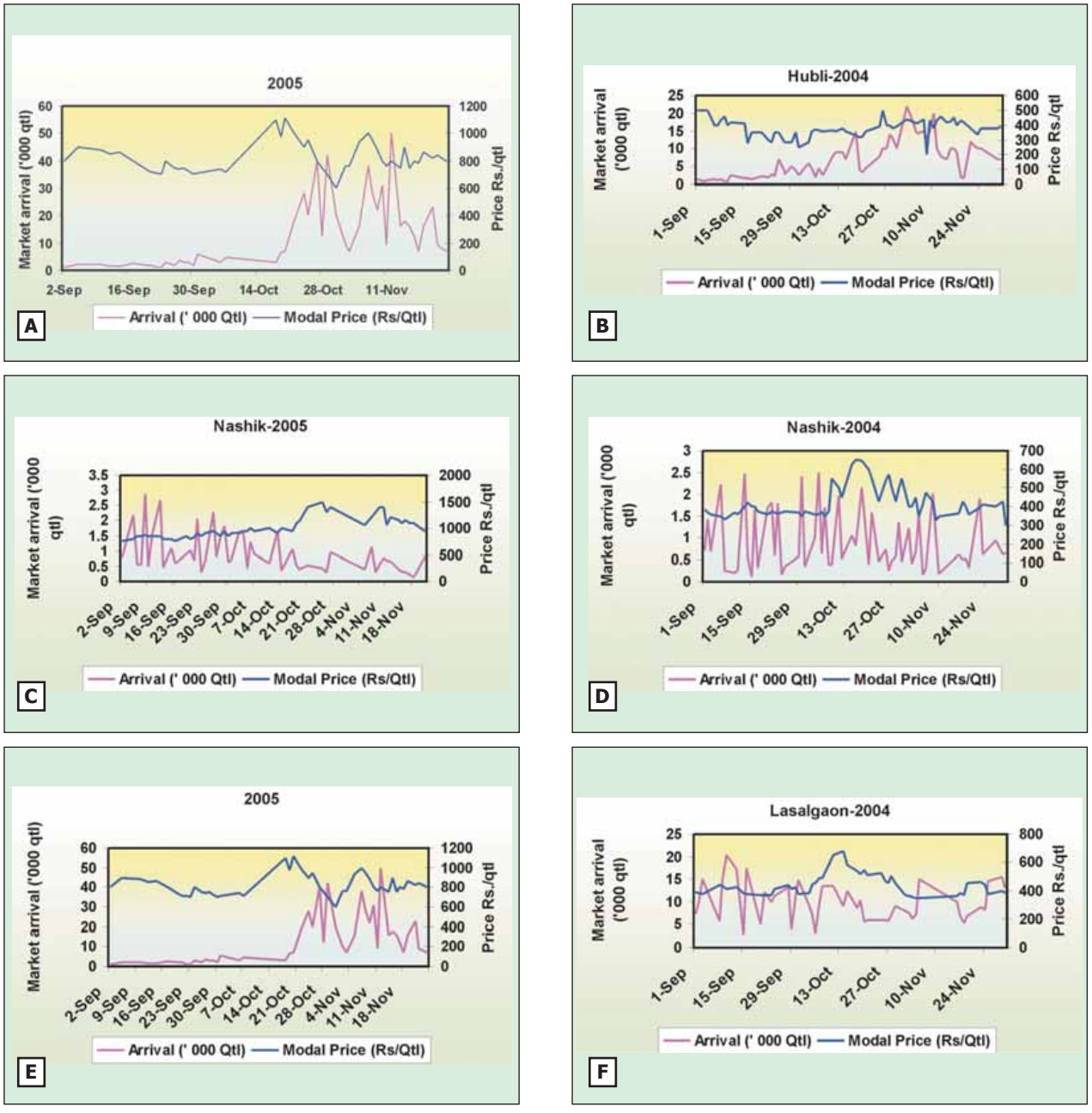


Figure 11 (A to F). Daily arrivals and modal prices in different onion markets in India

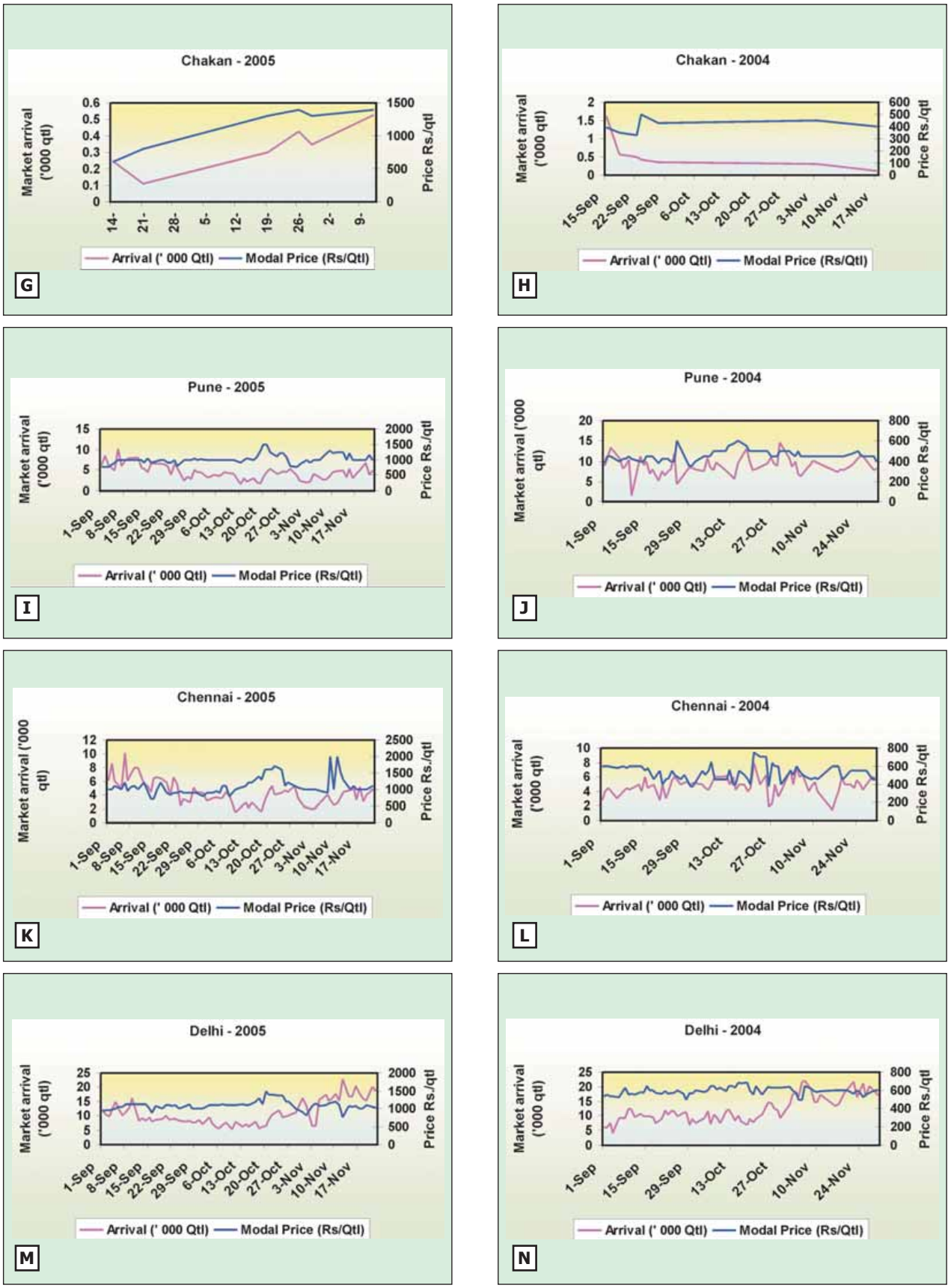


Figure 11 (G to N). Daily arrivals and modal prices in different onion markets in India

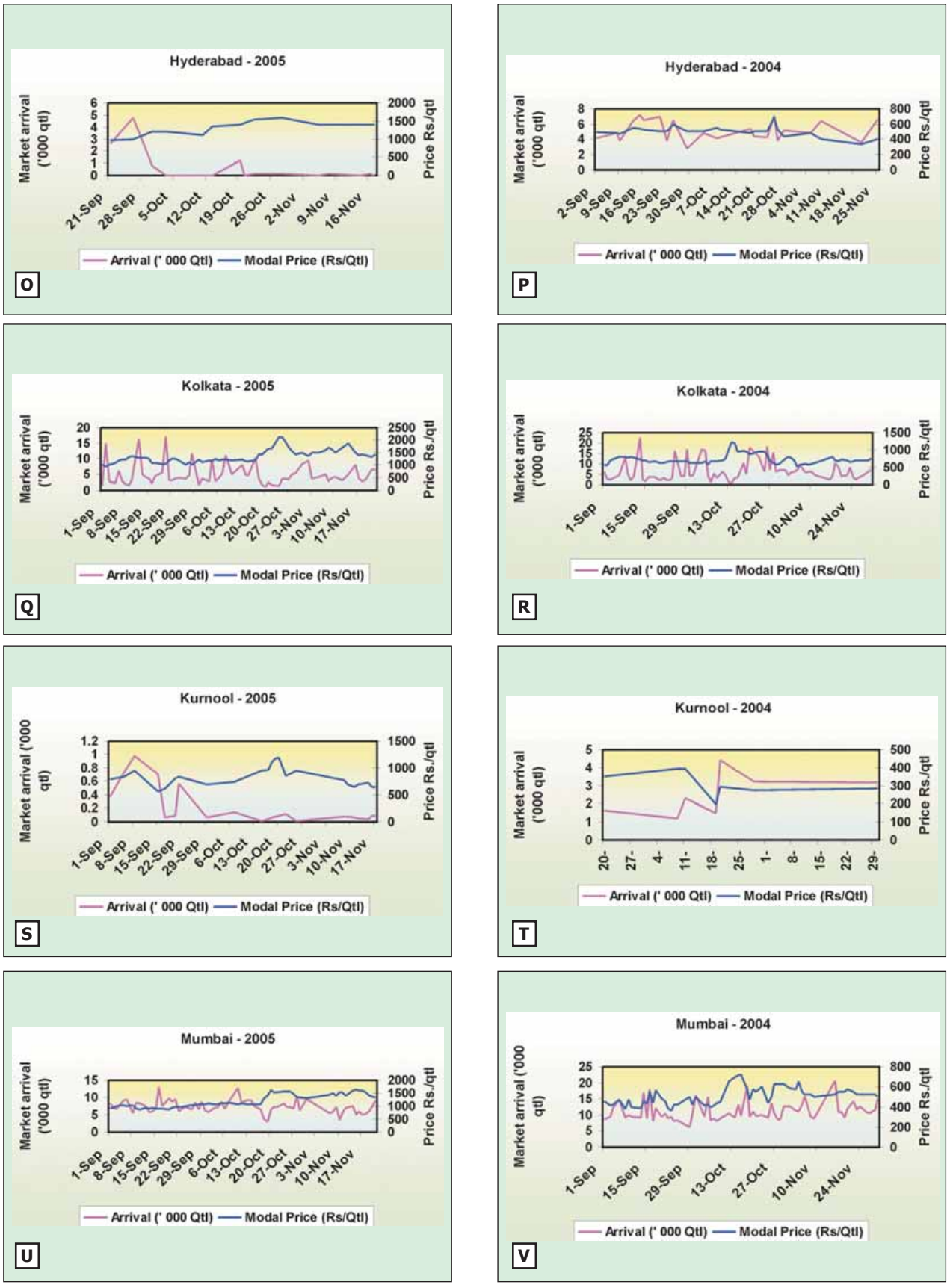


Figure 11 (O to V). Daily arrivals and modal prices in different onion markets in India

Using the monthly maximum prices prevailing during 2002 to 2005, seasonal variations in the onion prices were isolated under the time series analysis frame work. It was observed that the monthly indices were relatively high from August onwards with maximum index in October in all the four markets (Fig 12). These indices reflect the seasonal nature of onion production and marketing in metro markets in India. The gap in market arrivals during the period after September is responsible for the higher prices that prevail during September - November. Similarly, the prices tend to rule low during January - June. The monthly indices were lowest during the months of April - May because of the arrivals of *rabi* onion.

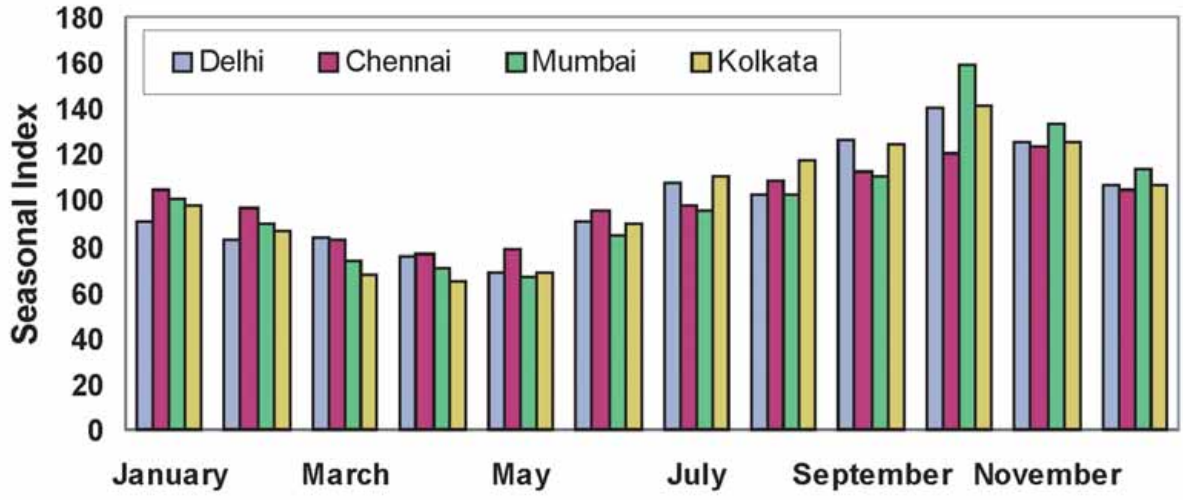


Fig 12. Seasonal indices for the four metro markets based on the whole sale prices

The 1998 Situation

The modal prices in Lassalgaon market ranged from Rs.186 to Rs.492 per quintal in 1996, and Rs.168 to Rs.837 per quintal in 1997 and Rs. 258 to 2632 in 1998 indicating spiraling of prices in 1998. Within the years, the prices during August-September and up to December were mostly on higher side than other months primarily due to exhaustion of stored produce coupled with delayed and reduced arrivals of fresh *kharif* harvest (mostly due to crop damage caused by excessive rains). Prices in 1998 however, remained higher and reached a record high level of Rs.26.32 per kg in October in Lasalgaon market. Similar was the case in other markets. The prices though started decreasing from November 1998, they were still higher as compared to the corresponding period during other years. From January 1999 onward, situation, however, improved when production increased due to different interventions from various agencies during late *kharif* season. Subsequently prices remained almost stable. However, during the period January to April prices from 1999 onward came down due to arrival of late *kharif* produce.

Producer and Consumer Losses in 2005

An interaction with researchers and farmers indicated that farmers suffered about 10-20 per cent losses during the *kharif* 2005 season. Very few farmers could take advantage of the spiraling prices that prevailed during October 2005 as the *kharif* sowings were delayed. Meanwhile, the imports exerted a downward pressure on the prices, which is evident. Since the yields have fallen, the higher prices may not translate into higher profits for farmers. Further, the producer share in the retail prices was found to be as low as 30 per cent in case of onion in areas not well connected to the markets. This means that the high prices the consumers are paying are not translating into higher incomes for farmers. The inefficiencies in the marketing channels account for such a situation wherein both consumers and producers do not gain.

It is estimated that the per capita consumption of onion in India is about 9.37 kg/year. The retail prices in many places increased from Rs.7 to Rs. 20/kg, an increase of 200 per cent. The consumers would have spent that much higher had they kept their consumption levels unchanged. Alternatively, they would have reduced their consumption by 60 per cent considering a price elasticity of demand of 30 per cent for onions.

5. Export of Onions

India has been traditional exporter of onions. Onions account for about two thirds of total vegetable exports. The exports of Onions increased from about 2.89 lakh tons in 1990-91 to 9.41 lakh tons in 2004-05. In terms of value, the exports increased from about Rs.118 crores to Rs. 817 crores during this period. The proportion of onions exported witnessed a decline after the 1998 crisis because of the changes in the government policies. As an immediate response to the 1998 crisis, the government imposed a ban on the exports and later on the exports were allowed on a 'quota' basis. The delays in notification of 'quotas' also influenced the exports to some extent.

As a result of the production crisis in 1998, the exports have fallen to about 2.98 lakh tons in 1998-99 and 3.18 lakh tons in 1999-00 from about 4.46 lakh tons in 1997-98. Similar is the experience in the current (2005-06) year also. Up to September 2005, only 3.78 lakh tons of onions were exported compared to 6.24 lakh tons exported till October 2004. (The total quantity of onions exported during the whole of 2004-05 was about 9.41 lakh tons) (Fig.13). In order to moderate the prices, the country had to import onions from Pakistan, Bangladesh and China. Thus, the country had to lose substantial foreign exchange earnings due to the fall in onion production caused by an abnormal monsoon.

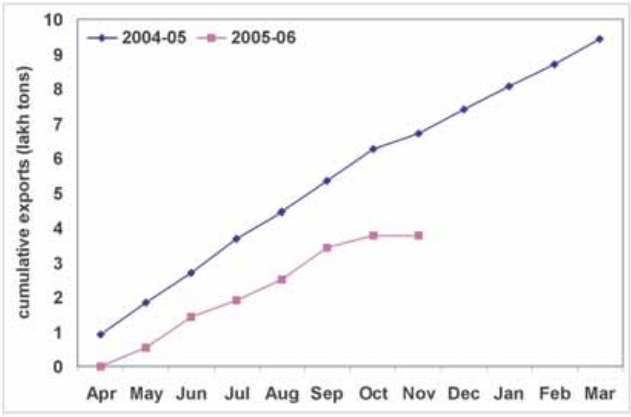


Fig 13. Changes in onion exports (lakh tons) during 2004-05 and 2005-06

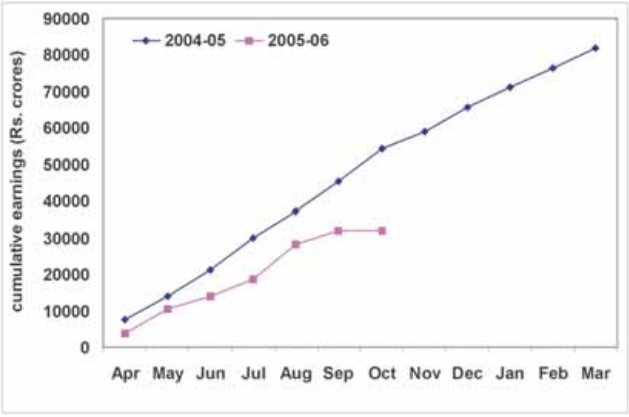


Fig 14. Changes in onion exports earnings (Rs. crores) during 2004-05 and 2005-06

6. Recommendations

Onions constitute an important part of the diet and also have therapeutic value in India. Any damage to the crop affects a vast majority of small and marginal farmers involved in the cultivation of this crop and majority of consumers. Hence, a comprehensive approach has to be taken to strengthen production-processing-marketing-consumption chain. An in depth constraint analysis is essential to bridge various gaps in the present systems. Through elaborate the discussions with farmers, market agencies and research organizations and also a rapid rural appraisal, we could flag some important issues and suggest probable solutions. They are presented below.

Improved Cropping Systems and Crop Husbandry

Continuous- and mono-cropping are not technically viable options as they build up development of inoculum of pathogens and insect-pests. Crop rotation thus is a must and some useful crop rotations suggested by NRCOG that were found to be good are given in table 9.

Table 9. Onion based cropping systems

Summer (Feb-May)	*Kharif* **(June-Sept.)**	**Late** *kharif* **(Sept -Feb)**	*Rabi* **(Nov-April)**
	Aster		Onion (N-2-4-1)
	Marigold		Onion (N-2-4-1)
	Potato		Onion (N-2-4-1)
	Groundnut		Onion (N-2-4-1)
	Soybean		Onion (N-2-4-1)
	Bajra		Onion (N-2-4-1)
	Onion (B-780)		Wheat
Groundnut		Onion (B.780)	
Cucumber		Onion (B.780)	

Based on the results,the most profitable onion based cropping system was aster (*kharif*) - onion (*rabi*) followed by bajra (*kharif*) - onion (*rabi*).

Improved crop husbandry practices such as raised bed system, crop rotation should be promoted to reduce losses by improving drainage systems and reduce losses due to diseases incited by pathogens during spells of water logging. Broad bed and furrow system has been demonstrated to improve yields significantly and also reduce losses due to temporary poor drainage conditions. However, farmers are not adopting this method. The probable reasons could be that the majority of small and marginal farmers (with 1-2 acres under onion) feel that the effective plant population is

reduced. However, research studies showed that the loss of planting area due to broad-bed and furrow system could be made up are due to improved bulb size. In ridge and furrow method, the farmers cultivating onions in black soils felt that drainage is a problem during prolonged rain spells.

The onions respond to heavy inorganic fertilization. However, excessive application of nitrogen is detrimental to the storage life of the produce. Hence, green manuring could be tried as an alternative to supplement the crop nutrition requirements.

Adjustment of Sowing Seasons

The present estimates for production of *kharif* including early *kharif*, late *kharif* and *rabi* are about 18, 22 and 60% respectively. It is possible to get fresh onions round the year in one or other regions if proper planting is done for production and post harvest management. Presently area in hills is very small. Further, in the South, the varieties being cultivated presently are not suitable for long distant transportation. Due to this reason, use of stored onion is common during the period July-October in most parts of the Country. Systematic crop cutting experiments should be conducted to assess the crop prospects and accordingly plan the marketing strategies. *Kharif* onion plays important role in filling critical gap from September to December in the country. Area under *kharif* crop in Maharashtra, Rajasthan, Karnataka should be increased. *Kharif* onion production technology developed by NRCOG should be popularised through frontline demonstrations.

Crop Water Balance

Onion crop is sensitive to both soil moisture deficit and excessive moisture. A poor efficiency of the farmers' practices and that of inadequate water supply leads to lower yields than in the case of optimal irrigation and efficient water management. Research studies showed that total yield was reduced by soil-water stress imposed at any growth stage but the greatest effect was at the 3- and 7-leaf stages reducing yields by 26%. Analysis of weekly water balance to identify surplus and deficit periods of moisture, which can critically influence the onion production, should be identified.

Improved Storage-life

Both *kharif* and late *kharif* onions are harvested during October-February. Since, these bulbs do not have dormancy, they sprout immediately. Also, the storage-life of these onions is very less as compared to the *rabi* produce. As all the produce arrives to the market simultaneously and a glut is created. The popular varieties normally being grown by farmers during *kharif* and late *kharif* do not have a good storage life. However, significant varietal differences were noticed among the varieties. The varieties like N-2-4-1 and Arka Niketan were superior to other varieties in their storage quality. Preference-wise, however, Baswant-780 is one of the most accepted type during late *kharif* even though it cannot be stored for more than 90 days after

harvest. Even this feature is very good as compared to local types used for planting which have a very low keeping quality. Hence, the research thrust should be to develop genotypes/ hybrids with *in-situ* dormancy and better storage life.

About 15-20% losses occur during harvesting, processing, and marketing. In store, the losses may be up to 40%. To reduce these losses, in addition to developing suitable cultivars, mechanization in harvesting, processing, grading and curing is essential. When unseasonal rains strike the crop during harvest, cost-effective storage structures should be developed to pump hot air into the storehouses for quick drying. Also, solar energy should be tapped for quick drying of the bulbs in storehouses especially in northern and eastern states.

Direct Seeding Systems

Improved agro-techniques should be developed for the direct seeding of onions to avoid losses at nursery level. If genotypic variability is available for direct seeding v/s transplanting, the same should be exploited to develop suitable varieties.

Integrated Nutrient and Pest Management Systems

Onion crop responds to fertilization. However, excessive application of inorganic nutrition leads to environmental pollution. Hence, use of organic forms of nutrition should be explored to supplement the nutritional requirement of the crop. Based on soil health test, site-specific nutrition recommendation should be developed to avoid abuse of inorganic fertilizers. Similarly, the micronutrient needs should also be given due attention. The NHRDF is providing the soil testing service to the farmers along with recommendation for application of nutrition where deficiency is noticed (Annexure 4). Use of plant growth promoting rhizobacteria could be promoted for making available nutrition and harmones to the onion seedlings for improved growth and thus yield. Seed bacterization with B2 strain of Bacillus subtilis eas found to enhance growth of onion seedlings.

The diseases and insect-pests were most critical for realizing robust productivity especially when the crop is exposed to abnormal weather conditions such as excessive rains or abnormal temperatures. An integrated insect-pest and diseased management schedule should be developed for each region and should be validated and refined for adoption by farmers. From the rapid rural appraisal, it was evident that the diagnostics for the diseases has been not very satisfactory. The farmers reported that they suffered considerable losses due to twister and purple blotch. As the symptoms of purple blotch and stemphylium blight are alike, it is difficult to distinguish them in the field by the farmers. Similarly, the basal rot, brown rot and soft rot are caused by different pathogens. Unless proper diagnosis is made at the field level, the diseases cannot be effectively managed.

Breeding for Disease Resistance

Basal rot caused by Fusarium oxysporum f.sp. cepae has been reported under excessive rain fall conditions. Currently, resistant cultivars are available for intermediate and long-day onions but not for short-day varieties. Cultivars, 'Dawn', 'Impala', 'La Nina', 'Navigator', 'NuMex Casper', 'NuMex Centric', 'Riviera', and 'Utopia' showed high levels of basal rot resistance. At the Indian Institute of Horticulture Research, IIHR-141, IIHR-506, and Sel 13-1-1 were resistant to basal rot in both laboratory and field screenings replicated over years. . basal rot. and 'Hybrid-1', 'IIHR Yellow', and 'Sel. 29' were also found to be resistant to basal rotfrom seed and bulb infection..

Hybrid Research

One of the main reasons for very high yields in Europe and American continents is the cultivation of hybrid onions where as in India mostly varieties are in vogue. In addition, the varieties that are gown in *kharif* and late *kharif* season are short day types and so cannot yield very high. Thus hybrid development need to be encouraged, as they could increase the yields and thus in turn profitability of the farmers substantially. For this purpose, male sterility could be successfully exploited.

Dormancy

In short day types, the bulbs normally do not have dormancy and show in situ sprouting. Normally after the neck fall stage, the onions are harvested. However, neck fall is artificially

induced through physical methods during *kharif* season. By inducing dormancy through genetic approach or through physiological means, the in situ sprouting of the bulbs could be prevented and the marketability of the produce could be increased.

Improved Seed Availability

Most of the farmers use their own seed and the produce from these varieties has a very poor storage life. Among the released varieties of onion, only a few are adopted by farmers and that too the certified seed of these genotypes covering only about 10% of the total demand. By adopting seed village concept, the seed replacement rate could be improved by providing high yielding varieties with better viability and shelf-life. Creation of medium-term facilities for onion seed will help in timely availability of quality onion seed. Encouraging promising NGOs to participate in breeder seed multiplication progrmame through revolving fund scheme could help in maintaining continous supply of demand-driven improved seed to the farmers. Subsidized quality seed should be provided to the farmers by the Government.

Farm Mechanization

Mechanization for the small and marginal farmers could increase the profitability of the onion farming, as the crop is labour-intensive. Development of implements suitable for small farms for transplanting, processing, harvesting and curing would reduce the farm drudgery and increase profitability of the small- and marginal-farmers who dominate the onion production systems. Custom-hiring centres for farm equipment may be promoted to increase the utilization of Farm machinery in field operations.

Curing & Drying

During *kharif* and late *kharif* season, especially when adverse climatic conditions such as cloudy weather or unseasonal rains prevail, sufficient energy is not available for timely drying of the bulbs. Improperly cured bulbs become more vulnerable to the attack by diseases during storage. Proper curing and drying can increase shelf-life of the bulbs considerably and thus reduce storage losses. Studies have shown that infrared irradiation at different intensity levels influenced dramatically the drying rate and the product qualities of onions.

High moisture content predisposes the bulbs to microbial attack soon after harvesting/picking. The development of processing facilities close to the growing areas is necessary to reduce the losses. A small scale dryer, developed Central Institute for Agricultural Engineering, Bhopal, India, at a constant air inflow rate of 0·33 m^3/sec, took about 12 h to reduce moisture content from 90 to 7.5% with inlet air temperature of 56°C for50 kg batches of onion slices. The overall energy utilization efficiency of the dryer for onions was 29.51%. The cost of the dryer was Rs. 12000 and the estimated cost of processing was Rs. 2.37 per kg of raw material.

Agro-advisories

Crop growing areas must be divided into different zones in all states based on growing periods. Genotypes and agronomic practices, which are cost-effective and easy to adopt should be developed for each zone. By analyzing the weekly rainfall distribution and its departure, the distribution pattern of the rainfall over years could be analyzed to develop effective forecasting systems. Based on the rainfall data, the length of growing period has to be calculated for all the years and the extent humid period should be analyzed to plan timely field operations.

Many disease prediction models have been developed for forewarning and timely management of diseases of onions. Models such as BOTCAST and DOWNCAST developed for the forewarning of Botrytis blight and downy mildew could be evaluated and refined, if found useful for use in issuing agro-advisories to the onion growers.

Marketing Reforms

Though onion production is taken up all over the country, the marketing is well organized in Maharashtra, Karnataka and Gujarat only. In many states the markets are not regulated and as such traders contact farmers directly in the

villages or they operate in weekly markets. Since there is not much competition, farmers do not get remunerative price. Also facilities for sorting, grading, curing or other marketing facilities do not exist due to which both farmers and traders suffer. It is, therefore necessary that marketing for onion be brought under regulated system as in Maharashtra, where open auction is compulsory in assembly markets. The facilities for grading, packing, curing, weighing etc. and stay for farmers if needed should be created. A proper market intelligence system and production forecast should be in place for assessing the actual market trends, developing marketing strategies and develop crop acreage plans for the subsequent seasons for all areas. In view of this many times at one place there is glut and at other place there is shortage. In such a weakly integrated market systems, both producers and consumers suffer whereas the traders gain from the price differences. There is, therefore a need to develop market information service cell at Agriculture Produce Marketing Committees in all the major producing packets and also consuming center so as to have proper feedback and facilitate quick transfer of stock from surplus to deficit areas. Farmers' cooperatives at village level should be developed which will go a long way in reaping higher benefits to them. Farmers should also be provided access to community-based storage structures at affordable cost.

The markets follow different methods across the Country such as open auction, under cover, tender and open agreement system. In all the systems, the role of government nominees should be proactive to protect the interest of both producer and trader to strike a balance. A contact farming system could also help the farmers to produce the required grade and quality. The export houses can use the same platform to meet the export demands. Facilitation of transport medium for long distance movement of the onions to promising markets can effectively hold the prices for the farmers.

A minimum support price for onions could avoid huge deviations in the prices of onions during the periods of glut and deficit. In the survey, farmers responded for a support price of atleast Rs. 500/- per quintal. Considering the cost of production and B:C ratios, a minimum support price of Rs. 350/- per quintal could be reasonable. Nevertheless, effective marketing system and export promotion policies have to be framed to maintain prices at around 500-600/- per quintal at retail level and Rs. 350/- per quintal at farmers' level.

Incentives for processing industries in production zones should be encouraged to avoid glut of the markets with the fresh produce and also the surplus produce is processed for value addition.

Capacity Building

Strengthening of extension education programme of farmers and training of extension workers fro adopting improved crop management practices is essential.

7. Epilogue

Among vegetable crops of India, Onions have attracted significant attention of researchers, bureaucrats and policy makers. The crop suffered huge losses due to abnormal weather events during rabi 1997, kharif 1998 and kharif 2005 causing considerable losses to producers and consumers drawing utmost attention of the government to urgently take up remedial measures to overcome the crisis. Excess rains have the potential to damage not only the nurseries of different seasons but also the main crop. Such situations could be avoided through agroclimatic characterization and development and effective communication of robust regional agro-advisories to the farmers regularly for efficient crop management. A proper diagnosis and management of the diseases of onions also appears to be of utmost importance to avoid huge losses to the crop during crop cultivation and storage. Integrated crop health management concept should be promoted with an emphasis on organic fertilization and use of biopesticides to improve the quality of the produce and thereby increasing the exports. Proper staggered planting of onions with suitable varieties can address supply gap during the months of September and October there by stabilizing the prices across the year uniformly. Adequate availability of the seed of improved varieties at affordable prices is a pre-requisite. Hybrid research should be given top priority to develop improved varieties with desirable qualities. As part of market reforms, minimum support prices for onions, and implementing market intelligence systems can help in discovering the right prices for producers. For avoinding glut, community-based storage facilities should be encouraged in all states taking Maharashtra as a model state where such facility is in place. The NRCO&G, NHRDF, and other NGOs should be brought under a network to work cohesively to address various issues related to onion agriculture.

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Annexure 1

State-wise Area, Production and Productivity of Onion (year 2004-2005)

State	Area (‘ 000 ha)	Production (‘ 000 tons)	% Contribution to		Productivity (tons/ ha)
			Area	Production	
Andhra Pradesh	20.90	186.75	4.80	3.14	8.94
Bihar	24.15	267.25	5.55	4.50	11.07
Gujarat	47.75	960.00	10.97	16.15	20.10
Karnataka	34.50	270.00	7.93	4.54	7.83
Madhya Pradesh	26.00	311.00	5.97	5.23	11.96
Maharashtra	80.98	1670.00	18.60	28.10	20.62
Orissa	55.50	488.00	12.75	8.21	8.79
Rajasthan	27.00	362.00	6.20	6.09	13.41
Tamil Nadu	19.25	222.50	4.42	3.74	11.56
Uttar Pradesh	53.75	563.00	12.35	9.47	10.47
Haryana	13.25	261.00	3.04	4.39	19.70
Other	32.25	381.00	7.41	6.41	11.81
Total	**435.28**	**5942.50**	—	—	—

*data source: NHRDF, Nashik

Annexure 2

Area and Production of Onion in Different Divisions of Maharashtra

District	Kharif 2003		Rabi 2003-04		Total	
	Area in ha.	Production in Mt.	Area in ha.	Production in Mt.	Area in ha.	Production in Mt.
Nashik	22903	252367	37708	541374	60611	793741
Dhule	1349	18094	2852	41653	4201	59747
Nandurbar	1500	20037	70	986	1570	21023
Jalgaon	1960	21634	3347	40689	5307	62323
Nashik Division	**27712**	**312132**	**43977**	**624702**	**71689**	**936834**
Ahmednagar	1888	16078	28115	280616	30003	296694
Pune	2838	22889	19708	302321	22546	325210
Solapur	800	3380	400	3061	1200	6441
Pune Divison	**5526**	**42347**	**48223**	**585998**	**53749**	**628345**
Satara	610	4187	1740	17266	2350	21453
Sangli			170	1687	170	1687
Kolhapur			130	1290	130	1290
Kolhapur Division	**610**	**4187**	**2040**	**20243**	**2650**	**24430**
Aurangabad	100	466	60	491	160	957
Jalna	150	695	50	409	200	1104
Beed	650	3009	25	204	675	3213
Aurangabad Division	**900**	**4170**	**135**	**1104**	**1035**	**5274**
Latur						
Osmanabad	250	2396	300	571	550	2967
Nanded						
Parbhani			521	4778	521	4778
Hinguli						
Latur Division	**250**	**2396**	**821**	**5349**	**1071**	**7745**
Buldhana	822	17761	822	17761		
Akola			385	9180	385	9180
Washim			247	5337	247	5337
Amravati			256	4670	256	4670
Yeotmal			245	5294	245	5294
Amravati Division	**0**	**0**	**1955**	**42242**	**1955**	**42242**
Wardha			293	3654	293	3654
Nagpur			800	9977	800	9977
Bhandara			202	2519	202	2519
Gondia			50	624	50	624
Chandrapur			53	661	53	661
Gadchiroli			75	935	75	935
Nagpur Divison	**0**	**0**	**1473**	**18370**	**1473**	**18370**
Kokan Division						**1178**
Maharashtra State	**34998**	**365232**	**98624**	**1298008**	**133622**	**1664418**

Annexure 3

Agronomy of Onion Crop

Onions can be grown on all types of soil provided the soils are deep friable and highly fertile. Sandy loams to clay loam soils are best suited for oinion cultivation. For good yield and quality bulbs, cool soils are better suited. The optimum soil pH range is between 6.5 to 7.5. Highly alkaline and saline soils are not suitable for onion cultivation as salt concentration above 4 m mhos/ cm2 inhibits vegetative growth of most of the onion cultivars. Good drainage is essential to get higher productivity. Onions are very sensitive to water logging.

Onion crop can be cultivated either by raising a nursery or through direct seeding. For kharif, late kharif and rabi season crops, the nursery is raised during the months of May-June, September-October and December-January, respectively. The recommended seed rate is 10 kg per hectare. Usually one-month-old seedlings are transplanted 10 to 15 cm apart. The crop requires about 20 tons of well decomposed farmyard manure to be incorporated into the soil at the time of land preparation. The recommended dose of inorganic fertilizers is 125 kg of nitrogen, 60 kg of phosphorus and 100 kg of potassium per hectare. One-half dose of nitrogen applied at the time of transplanting and the remaining half is applied as top dressing after about a month of transplanting. Excessive application of nitrogen and also continued irrigation even after maturity reduces storability of onion bulbs. It is therefore, desirable to apply only recommended doses of nitrogen and stop irrigation 10-15 days before harvesting. Restricting excessive and delayed nitrogen application (not exceeding 100 kg/ha under normal fertility condition and application of N in 2-3 splits within 60 days of transplanting), use of ammonium sulphate instead of urea for top dressing, more use of organic manures to fulfill nutritional requirement, use of vermicompost, and neem cake etc. also improv productivity. Delayed top dressing produces thick neck or doubles. The requirement of nutrients will depend on soil type, region of growing, varieties and removal of major nutrients. Following are some of the recommendations on manuring and fertilization for different varieties / areas in addition to 20 tons of FYM.

Details of fertilizer			Variety / season	Area
N	P	K		
150	60	00	N-53 (kharif)	Rahuri (MS)
150	80	00	Pusa Red (rabi)	Karnal (Haryana)
150	40	50	Agrifound Dark Red (kharif)	Karnal (Haryana)
150	60	60	Pusa Red (rabi)	Jabalpur (MP)
100	50	50	Punjab selection (rabi)	Ludhiana
80	00	00	Patna Red (rabi)	Sabour (Bihar)
100	80	50	Arka Kalyan (kharif)	Hasarghatta (Bangalore)
100	80	50	Arka Pragati and Arka Niketan (rabi)	Hasarghatta (Bangalore)
125	50	125	Bangalore Rose (rabi)	Karnataka
60	60	30	Multiplier	Tamil Nadu
100	50	50	Agrifound Light Red (rabi)	Karnal
100	25	25	Agrifound Light Red (rabi)	Nashik

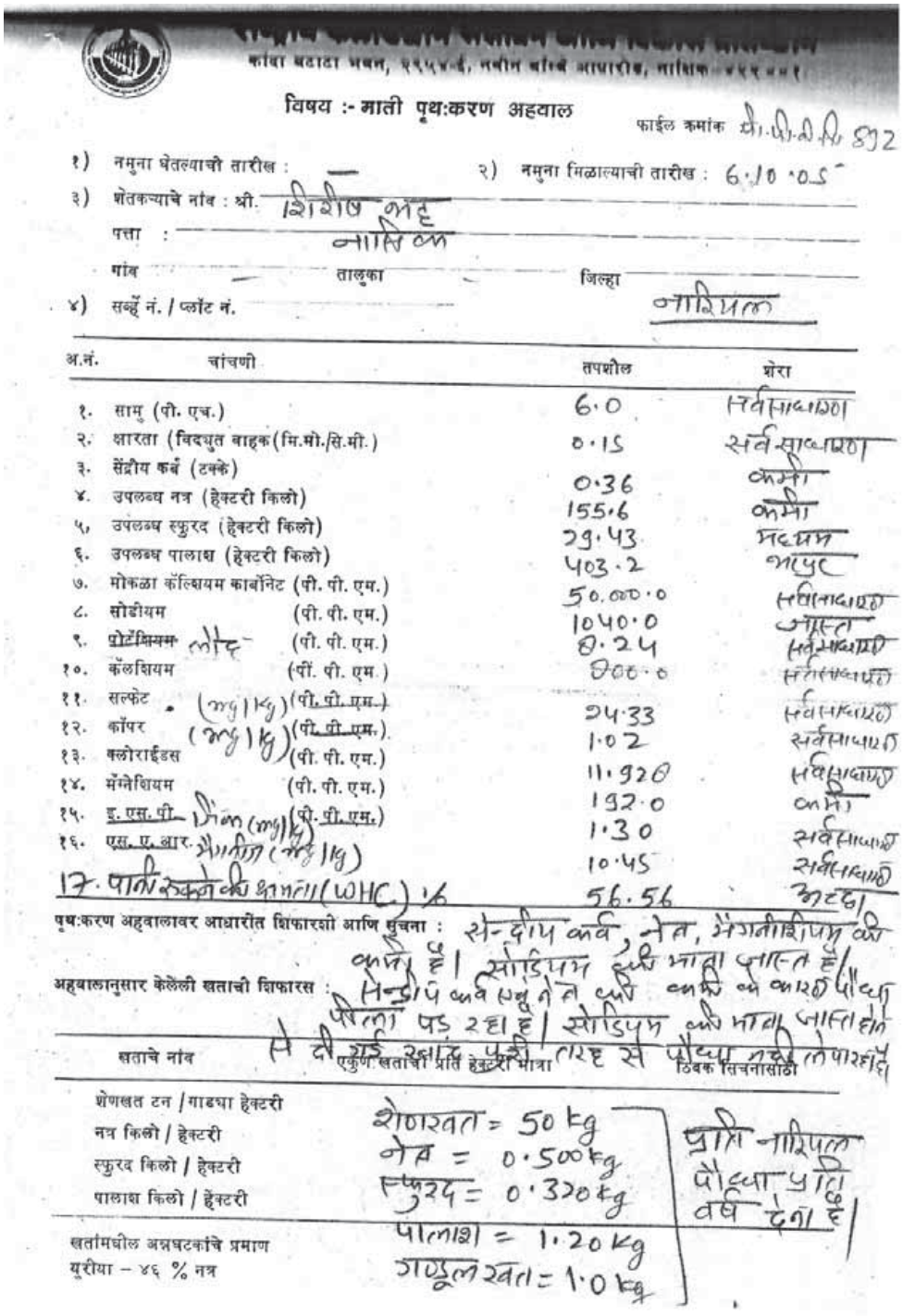
In addition to fertilizer, application of micronutrients has been reported to be beneficial in improving the quality of bulbs. Application of Zinc @ 1.2 and 3 ppm increased the yield and enhanced quality of bulbs by increasing the Total Soluble Solids (TSS), sugar and ascorbic acid. Copper and boron @ 13.4 kg and 1.8 kg/ha, respectively were beneficial in increasing yield. At Nashik application of Zn @ 3 ppm, copper @ 1 ppm, and boron @ 0.5 ppm at 45 and 60 days after planting in kharif onion crop gave higher returns. The application of polyfeed (19:19:19:TE) @ 1% at 15, 30 and 45 days as foliar sprays and multi-K (13:0:46) @ 1% at 60, 76 and 90 days improved yields as well as storability in onion.

The crop should be irrigated so that the moisture content of the soil is kept at the optimum level. A dry spell, followed by irrigation, may cause the splitting of the outer scales. Irrigation is stopped when the tops mature and start falling. Over watering of the crop is always harmful. Irrigation at 1.25 times of cumulative pan evaporation with reduced N and reduced irrigation frequency (depending on weather conditions) and more gaps between two irrigations till 60 days after transplanting was beneficial. Similarly last irrigation 10-15 days before harvest reduced microbial losses in stored onion compared to withholding of irrigation before 5 days. The hybrid varieties usually yield more as compared to other varieties. For the economic production of hybrid seed male-sterile lines are used.

The crop should be harvested when it is 75% physiological matured and the tops fall. However, in kharif crop, the tops do not fall. Hence, the bulbs are harvested when bulbs are fully developed, the colour of leaves has changed from green to yellowish colour and drying has started from top. In rabi, harvesting should be done one week after 50% tops have fallen over. Premature harvesting can result in increased losses due to physiological loss in weight, decay and also sprouting. After harvesting, the tops of bulbs should be cut leaving 2-2.5 cm above the bulbs after curing. Pre-harvest sprays of Maliec hydrazide @ 2500 ppm, carbendazim @ 0.1% and streptocycline @ 0.02% are effective in controlling storage losses.

Annexure 4

A TypicalSoilTesting Report Provided by National Horticultural Research Foundation, Nashik



कांदा बटाटा भवन, २२५४-ई, नवीन सांगवी आधारीड, नाशिक-४२२ ००१

विषय :- माती पृथःकरण अहवाल फाईल क्रमांक पी.पी.डी.ए. 592

१) नमुना घेतल्याची तारीख : — २) नमुना मिळाल्याची तारीख : 6.10.05

३) शेतकऱ्याचे नांव : श्री. दिनेश आहेर

पत्ता : नाशिक

गांव — तालुका — जिल्हा नाशिक

४) सर्व्हे नं. / प्लॉट नं.

अ.नं.	चांचणी	तपशील	शेरा
१.	सामु (पी. एच.)	6.0	सर्वसाधारण
२.	क्षारता (विद्युत वाहक (मि.मो./सि.मी.)	0.15	सर्वसाधारण
३.	सेंद्रीय कर्ब (टक्के)	0.36	कमी
४.	उपलब्ध नत्र (हेक्टरी किलो)	155.6	कमी
५.	उपलब्ध स्फुरद (हेक्टरी किलो)	29.43	मध्यम
६.	उपलब्ध पालाश (हेक्टरी किलो)	403.2	भरपूर
७.	मोकळा कॅल्शियम कार्बोनेट (पी. पी. एम.)	50.000.0	सर्वसाधारण
८.	सोडीयम (पी. पी. एम.)	1040.0	जास्त
९.	पोटॅशियम (पी. पी. एम.)	0.24	सर्वसाधारण
१०.	कॅलशियम (पीं. पी. एम.)	800.0	सर्वसाधारण
११.	सल्फेट (mg/kg) (पी. पी. एम.)	24.33	सर्वसाधारण
१२.	कॉपर (mg/kg) (पी. पी. एम.)	1.02	सर्वसाधारण
१३.	क्लोराईडस (पी. पी. एम.)	11.920	सर्वसाधारण
१४.	मॅग्नेशियम (पी. पी. एम.)	192.0	कमी
१५.	इ. एस. पी. (mg/kg) (पी. पी. एम.)	1.30	सर्वसाधारण
१६.	एस. ए. आर. (mg/kg)	10.45	सर्वसाधारण
17.	पाणी रोखण्याची क्षमता (WHC.) %	56.56	अहवाल

पृथःकरण अहवालावर आधारीत शिफारशी आणि सुचना : सेंद्रीय कर्ब, नेत्र, मॅग्नीझ ही कमी आहे। सोडियम ची मात्रा जास्त आहे। सेंद्रीय कर्ब व नत्र कमी असल्याने पीक पिवळे पडत आहे। सोडियम ची मात्रा जास्त असल्याने ते दिलेले खत मुळांद्वारे पिकास शोषले जात नाही

अहवालानुसार केलेली खताची शिफारस :

खताचे नांव	एकुण खताची प्रति हेक्टरी मात्रा	ठिबक सिंचनासाठी
शेणखत टन / गाडगा हेक्टरी	शेणखत = 50 kg	प्रति गाडीपाल पौधा प्रति वर्ष देणे
नत्र किलो / हेक्टरी	नेत्र = 0.500 kg	
स्फुरद किलो / हेक्टरी	स्फुरद = 0.320 kg	
पालाश किलो / हेक्टरी	पालाश = 1.20 kg	
खतांमधील अन्नघटकांचे प्रमाण युरीया – ४६ % नत्र	गंधूल खत = 1.0 kg	

त्याप्रमाणे खतांचे प्रमाण वेगवेगळ्या खतांसाठी वाढवे

वाढलेला पी. एच. कमी करण्यासाठी ढोबळ सूचना

१. जमिनीचा चोपणापणा वाढत/वाढलेला आहे. त्यासाठी उताराप्रमाणे चर काढून पाण्याचा निचरा चांगला होईल अशी काळजी घ्यावी.

२. हेक्टरी ५ ते १० टन जिप्सम पूड व ३० ते ५० गाड्या चांगले कुजलेले शेणखत जमिनीत मिसळून घालावे/साखर कारखान्यातील मळी (प्रेसमड) २५ ते ५० गाड्या घालाव्यात.

३. हिरवळीच्या खतासाठी ताग, धैंचा, शेवरी यासारखी पिके घेऊन फुलावर येताच जमिनीत गाडावीत.

४. भात, कपाशी, गहू, धैंचा, शेवरी यासारखी पिके घ्यावीत

वाढलेले क्षार कमी करण्यासाठी ढोबळ सूचना

जमिनीत क्षाराचे प्रमाण वाढत/वाढलेले आहे. त्यावर खालील उपाय करावेत.

१. जमिनीच्या पृष्ठभागावर आलेले क्षार खरवडून शेताबाहेर टाकावेत.

२ जमिनीचे लहान लहान वाफे करुन त्यात थोडावेळ वाफा भरुन पाणी साठवून एकदम चरावाटे बाहेर काढून टाकावेत म्हणजे पाण्याबरोबर क्षार बाहेर जातील.

३. चर खणून पाण्याच्या निचऱ्यासाठी चांगली सोय करावी.

४. भरपूर प्रमाणात गांडळी खते (सेंद्रीय खते) वापरावीत

५. हिरवळीच्या खतासाठी धैंचा, शेवरी, ताग यासारखी पिके घेऊन फुलावर येताच जमिनीत गाडून टाकावीत,

६, क्षारास दाद देणारी पिके कांदा, कापुस, गहू, भात इत्यादी घ्यावीत.

टिप – २) अहवालामधील प्रमाण कमी, मध्यम, जास्त नमूद केलेले आहे. त्या प्रमाणात वरील सूचनांचा विचार करावा व खतांचे प्रमाण कमी अधिक करावे.

अ) **मातीच्या नमुन्याचा पृथःकरण अहवाल –**

अहवाल	अहवालाचे स्पष्टीकरण
१. आम्ल विम्ल निर्देशांक (पी.एच.) आम्ल/सर्वसाधारण/विम्ल)	१) अम्ल विम्ल निर्देशांक ६.०० पेक्षा कमी असल्यास आम्लयुक्त. २) ६.१ ते ८.५ पर्यंत पिकास मानवणारे (सर्वसाधारण) ३) ८.६ ते ९.०० पर्यंत विम्ल होण्याचे मार्गावर
२. क्षारता (सर्वसाधारण/हानिकारक)	१) १.०० पर्यंत सर्वसाधारण २) १.०१ ते २.०० पर्यंत पीक उगवणीस नुकसानकारक ३) २.०१ ते ३.०० क्षार संवेदनक्षम पिकाच्या वाढीस नुकसानकारक.
३. सेंद्रीय कर्ब (टक्के)	१) ०.५ कमी २) ०.५१ ते ०.७५ मध्यम ३) ०.७५ चे पुढे भरपुर
४. उपलब्ध स्फुरद (हे. किलो)	१) २२ कमी २) २३ ते ५६ किलो मध्यम ३) ५६ चे पुढे भरपुर
५. उपलब्ध पालाश (हे. किलो)	१) ११२ कमी. २) ११३ ते २८० मध्यम ३) २८० चे पुढे भरपुर
६. मोकळा कॅल्शियम कॉर्बोनेट (टक्के)	१) ५ साधारण २) ६ ते १० मध्यम ३) १० चे पुढे भरपूर

सुचना – माती परीक्षणाच्या अहवालानुसार दिलेल्या खतामुळे माती परीक्षण न करता दिलेल्या खतापेक्षा उत्पन्नात वाढ/घट आली काय हे संबंधित प्रयोगसाळेस कळविणे वरील मृद विश्लेषणाचा उपयोग कोर्टाचे कामाकरीता करता येणार नाही.

दिनांक : 22/10/15

स्थळ : गांधीनगर

Nithil Shah

प्रयोगशाळा प्रभारी

Annexure 5

Insect-pests of Onion

Onion Thrips *(Thrips tabaci)*

Thrips are the most injurious insect pest of onion and is common all over the country and can cause up to 50 to 60% losses in bulb crop. Infested leaves show spots and turn pale white blotches due to drainage of sap. Thrips are found in the axil of green leaves where they suck juice of early emerging leaf. The infested plants show stunted growth with twisted leaves. If the infestation comes in early stage of the growth, the bulb formation stops completely and plants die slowly.

The adult thrips hibernate in the soil, on grass and other plants in the onion fields. They also over-winter in bulbs and act as a source of infestation for the following year. Thrips multiply in large number during March-April on seed and bulb onions in the northern parts of India whereas at Nashik incidence is observed even in January-February. Bulbs in store are also attacked by thrips. Malathion @ 0.1% or metasystox @ 0.1% and cypermethrin @ 0.01% or deltamethrin 2.8 active ingredient (ai) @ 20 ml/ha are recommended to manage the pest. Soil application of phorate or carbofuran granules @ 1 kg ai/ha is also recommended. The alternate sprays of Neem based insecticides are also found effective in reducing thrips population.

Onion Maggot *(Hylemia antiqua)*

The adults of the insect appear like housefly. The flies lay their eggs on old leaves or on soil and larva enters into soil and damage disc portion of onion bulb. Infested plants turn yellowish brown and finally dry up. The affected bulbs rot in storage as infestation leads to secondary infection by pathogenic organisms. The crop rotation be followed and thimet should be applied in the soil before transplanting.

Cutworms *(Agrotis ipsilon)*

The larva of this insect is seen in nursery beds and newly transplanted onion fields. The tender plants are found damaged at ground level during the night. The mouth of the insect has dull brownish forewings with numerous wavy lines and spots and brown coloured hind wings. The larva is dark brown with a red head. Soil application of carbofuran @ 1 kg active ingredient / ha at the times of planting is recommended. Chloropyriphos @ 5 ml/lit of water also gives good control of this pest.

Mites *(Rhizoghyphus sp.)*

Dry weather is conducive to infestation of mites. It sucks the sap turning the plants pale with sticky appearance. It also infects the stored onion and induces sprouting. The mite is reddish green with eight legs and measures about 4 mm. Application of sulphur dust @ 22 kg/ha is recommended. Sprays of kelthane @ 0.1% also give good control of mites.

Annexure 6

Storage and Transport of Onions

Onion storage is essential to maintain the supply of bulbs round the year and also to stabilize the prices. Generally, the rabi produce has a better storage life as compared to kharif and late kharif produce. The storage life of onion depends on various parameters such as genotype, crop husbandry, crop health management, curing and drying of the produce and storage conditions.

A wide range of variability in storage life has been recorded for Indian onion varieties. N-2-4-1, Pusa Madhvi, Agrifound Light Red, Arka Niketan, and Pusa Red have been found to possess better storage life. The varieties with poor storage life generally have low TSS, low dry matter content, high relative loss of water immediately after harvest and poor skin retention with only one skin layer. N-53, Baswant-780, Agrifound Dark Red, and Arka Kalyan do not keep well, however, if properly cured in shade for 10-12 days before storage, these can be stored for 1-2 months. The varieties that loose fresh mass fast are more susceptible to storage rots and sprout readily. The varieties Early Grano and Tropic Brown excaliber having yellow colour and no TSS are poor storer varieties. Bigger bulbs sprout at a faster rate than smaller and immature bulbs. Hence, medium size round bulbs should be used for storage.

Field curing by window method, shade curing with tops for 10 days and 2.5 cm neck cut are found effective in reducing storage losses. Field curing should be done till foliage turns yellow and necks become thin. Then curing should be done in shade with adequate ventilation so that field heat is removed and bulbs are saved from sun scalding, colour is improved and surface becomes dry. Bulbs intended for storage must be free from cuts and bruises. The bulbs should not be dropped on to non-resilient surface from more than 6" height. If onions are to be stacked after packing in storage or truck the optimum height is 6 to 8 ft. Loose packing or storage in wooden or plastic crates or leaving loose reduced storage rots as compared to storage in gunny bags. Handling should be minimum after storage to minimize post harvest losses.

Sprouting in onion is affected by temperature. The temperature between 10-12^{o}C to 25^{o}C increases sprouting. Rooting is positively correlated with the relative humidity. The bulbs lose more mass above 35^{o}C. The optimum conditions for storage are 30- 35^{o}C and 65-70% RH under ambient conditions and in cold storage, 0-2^{o}C and 60-70% RH. Sprouting can be checked effectively if maleic hydrazide @ 2500 ppm is sprayed at 75 days after transplanting. The storage rots could be checked if proper cleanliness is maintained in store and crop is sprayed with carbendazim @ 0.1% at 90 days after transplanting.

Storage Structures

Common storage structure across the Country vary slightly in flooring. In North near Panipat (Haryana) or Jalalabad (UP) the structures are made of bamboo or sarkanda nets and the roof is thatched one or made of sirki, which is covered on top with jute cloth. The size is 1.2 x 1.2 x 3 cm and the capacity is 40 quintal. The bottom net is fixed at about 30 cm height from ground level to have aeration. The present cost is about Rs.4000 to Rs.5000.

In Nashik area the structures are called chawl. These have sides made of bamboo or other woods spread at 1-2 cm apart and roof is made of either thatch, asbestos sheets or tiles or GI sheet. There is no bottom ventilation but flooring is done with the help of soil, stone particles and sand and is raised from ground level. Size of store varies from area to area. Normally width is kept as 1.5 m and height is about 1.5 m. The length may vary from 13.5 to 30 m. The capacity varies from 200 to 600 quintal. The cost from Rs.65,000 to Rs.2,00,000. The available structure in Tamilnadu is similar to north except that length is more and stone pillars are used for support and coconut leaves and dry grass used for roof.

In Bihar structures have 2-3 tiers whereas in Gujarat the structures have single to double tiers. The loading height is 1.2 - 1.5 m at all the places except Bihar where it is 30-60 cm. There is enough ventilation through windows in the walls and also raised flooring at some height. The losses in these structures vary from 30-50%.

Nafed has constructed two and three tier structures in Maharashtra in which losses are much lower. NHRDF has developed model design for two tier in Panipat and single tier in Nashik having adequate ventilation from all sides including bottom. Such structures should be constructed for reducing storage losses particular decay by the farmers and others concerned as losses in these structures are reported to be reduced significantly.

The salient features of improved storage structures are as under :

1. Construction of storage godown on raised platform to prevent entry of moisture and creation of dampness
2. Use of Mangalore tile roof or other suitable material to prevent built up of high temperature inside
3. Increased central height and more slope for better air circulation and preventing humid microclimate inside godown
4. Providing bottom ventilation for free and faster air circulation to avoid formation of hot and humid pockets between the onion layers
5. Avoid direct sunlight on onion bulbs to reduce sunscald, fading of colour and quality deterioration
6. Restriction on width of each stack to 60-75 cm for cool humid weather, 75-90 cm for mild and humid weather and 90-120 cm for mild and dry weather conditions

7. Maintenance of stacking height to 100 cm for small and multiplier onion and hot weather and 120 cm for mild weather and for big onion to avoid pressure bruising

8. Provide cubicles instead of continuous stack and sufficient space for ventilation from all sides

9. One cubic meter area of store accommodates about 750 kg onions. Accordingly, construction of godown for required capacity and construction of more units instead of single big structure and in zigzag manner when constructed in more rows

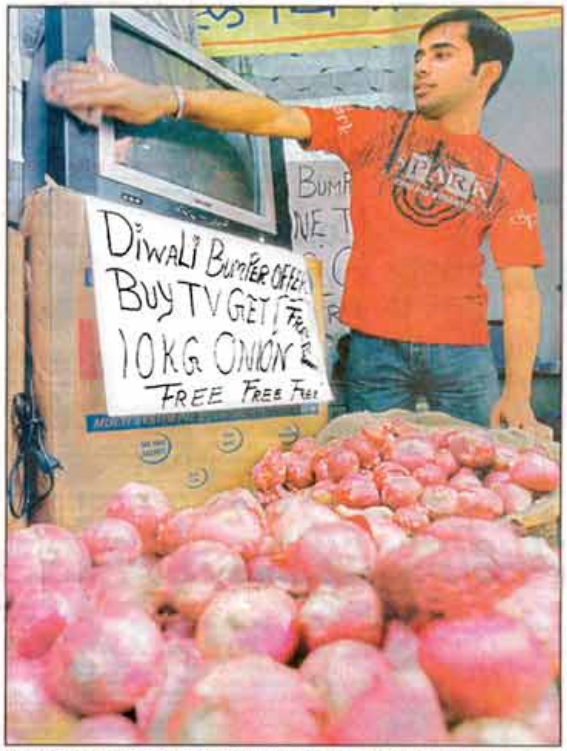
10. Providing two tier if space available is insufficient

11. Periodical disinfections of structures and premises to check rottage

All for a slice of onion

The Hindu, Sunday, December 4, 2005

The great Diwali offer



Tears for fears: A home appliance shop owner offers a gift of 10 kgs of onions to customers who purchase a television or any other appliance in Amritsar on Wednesday. The shortage of onions in the market has resulted in a price hike all over the country. People fear that the prices could go even higher. *(PTI)*

Deccan Chronicle, Thursday, October 27, 2005